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Seasonal Spatial Distributions of Groundfishes of the Scotian Shelf and Bay of Fundy, 1974-79 and 1980-84

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SEASONAL SPATIAL DISTRIBUTIONS OF GROUNDFISHES OF THE SCOTIAN SHELF AND BAY OF FUNDY, 1974-79 and 1980-84

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ABSTRACT

Scott, J. S. 1988. Seasonal spatial distributions of groundfishes of the Scotian Shelf and Bay of Fundy, 1974-79 and 1980-84. Can. Tech. Rep. Fish. Aquat. Sci. 1653: iii + 8 p. + 33 fig.

Geographic distributions of common groundfish species of the Scotian Shelf and Bay of Fundy are presented for the aggregated 5-yr summer periods 1975-79 and 1980-84, and for spring and autumn 1980-84. Distributions are compared and related to both mid-term and seasonal fish movements. Comparison of 1975-79 and 1980-84 summer distributions show little geographical change but more dense concentrations of major species in the latter period. Seasonal comparisons show withdrawal of most species from the Bay of Fundy and shallow waters of the Scotian Shelf by spring, presumably representing the winter/early spring distributions in warmer water. Autumn distributions were similar to those of summer except for certain species such as silver hake, pollock and spiny dogfish where late season movements were related to spawning activity in silver hake and, presumably, to withdrawal to overwintering areas for the others.

RÉSUMÉ

Scott, J. S. 1988. Seasonal spatial distributions of groundfishes of the Scotian Shelf and Bay of Fundy, 1974-79 and 1980-84. Can. Tech. Rep. Fish. Aquat. Sci. 1653: iii + 8 p. + 33 fig.

Le rapport présente les distributions géographiques des espèces communes de poisson de fond dans la plate-forme néo-écossaise et la baie de Fundy pendant l'été sur deux périodes globales de cinq ans, c'est-à-dire de 1975 à 1979 et de 1980 à 1984 ainsi qu'au printemps et à l'automne de 1980 à 1984. Les distributions sont comparées et mises en rapport avec les déplacements des poissons selon les saisons et avec les déplacements notés au milieu de la période globale de cinq ans. La comparaison de la distribution estivale de 1975-1979 avec celle de 1980-1984 indique peu de changements sur le plan de la distribution géographique, mais révèle des concentrations plus denses des principales espèces dans la période allant de 1980 à 1984. Les comparaisons selon les saisons témoignent qu'au printemps la plupart des espèces se sont retirées de la baie de Fundy et des eaux peu profondes de la plate-forme néo-écossaise, ce qui illustre peut-être la distribution caractéristique de l'hiver et du début du printemps dans les eaux plus chaudes. Les distributions de l'automne étaient samblables à celles de l'été sauf pour certaines espèces comme le merlu argenté, la goberge et l'aiguillat commun où les déplacements tardifs de l'automne étaient associés au frai du merlu argenté et peut-être, pour les autres espèces, au retrait vers les zones d'hivernage.

INTRODUCTION

The following report complements a previous publication (Scott 1976) showing summer distributions of groundfish on the Scotian Shelf for the 5-yr period 1970-74. It presents similar information for the subsequent 5-yr periods 1975-79 and 1980-84. In addition, spring and autumn distributions for the latter period are presented to illustrate seasonal variation. The text of the former report is reproduced in a large part as the information is general and applies equally well to the present report. To this are added observations on changes in distribution in the 10-yr period covered by this report and on seasonal changes in the last 5-yr period.

The data on which this report is based are derived from groundfish research trawling surveys on the Scotian Shelf and in the Bay of Fundy. The series started in 1970 as annual, standardized summer surveys based on a depth-stratified random design (Halliday and Koeller 1981) and was supplemented by seasonal surveys in March and October each year from 1980-84 inclusive. One identifiable difference in the surveys in the two time periods lies in the research vessels (Table 1) and gear used. The A.T. Cameron used a Yankee #41 bottom trawl while the Lady Hammond and Alfred Needler used the Western IIA bottom trawl. The trawl dimensions are comparable although the Western IIA has a higher headline (Carrothers 1988). The change occurred in 1981-82 and affected summer surveys only. Another notable change was in the extension of jurisdiction with imposition of the 200-mile limit. The fish population response to this would take some years to appear and could well be the major factor in the higher catches of the 1980-87 period as evidenced in the distributional maps. A total of about 150 fishing stations was occupied on each survey (Table 1), covering the area from the Bay of Fundy and eastern Gulf of Maine in the southwest to the Laurentian Channel in the northeast (Fig. 1).

The outward limit of the surveys was the 366 m (200-fath) contour on the slope of the continental shelf. The inner limit was dictated by the suitability of the seabed for trawling. It was about the 91 m (50-fath) contour between the Nova Scotia coast and the offshore banks but extended to about 37 m (20 fath) in the Bay of Fundy. The area off southwest Nova Scotia to the north of Browns Bank and the continental shelf (183-366 m; 100-200 fath) southeast of Banquereau Bank were excluded because of the excessively rough bottom and consequent difficulties in operating the fishing gear.

The extensive area covered (approximately 50,000 square nautical miles (nm^2)), and limited vessel time available, resulted in minimal coverage of the area, with an average of one fishing station per 300-350 nm^2 on each annual survey. This coverage was sufficient to provide a gross measure of changes in relative abundance of the various fishes but not a detailed picture of fish distribution in any one year or to show, reliably, year-by-year changes in distribution. However, assuming relatively similar dispositions of the fish stocks during a given season from year to year, the aggregate of each 5 years' surveys is considered to provide sufficient coverage as a basis for an average account of the areas frequented by the various fish species.

Table 1. Dates, cruise numbers and numbers of sets for standard research vessel bottom trawl surveys of the Scotian Shelf and Bay of Fundy, 1975-84. Vessel designations: A - A.T. Cameron, H - Lady Hammond, N - Alfred Needler.

Year	Cruise	Season	No. sets
1975	A236-237	Summer	145
1976	A250-251	Summer	153
1977	A265-266	Summer	145
1978	H279-280	Summer	148
1979	A292-293	Summer	155
1980	H033-034	Spring	114
1980	A306-307	Summer	150
1980	H042-043	Autumn	145
1981	A321-322	Spring	124
1981	H059-060	Summer	148
1981	H064-065	Autumn	140
1982	H071-072	Spring	136
1982	H080-081	Summer	155
1982	H084-085	Autumn	168
1983	H094-095	Spring	149
1983	N012-013	Summer	149
1983	N017-018	Autumn	185
1984	N024-025	Spring	174
1984	N031-032	Summer	146
1984	N036-037	Autumn	170
		Total	2999

The fish catches are expressed graphically (Fig. 3-33) as weight (kg) of fish per ½-h tow except for a few species of fish which were so small in size and weight as to preclude their inclusion on that basis. The distribution of such species is represented in terms of numbers caught; for all other species, the figures give no indication of the numbers or sizes of fish involved. This treatment may not represent fish distribution in terms of numbers of fish if different size groups of a species exhibit different depth preferences, or where catches are predominantly of large specimens, such as in the cases of pollock and angler.

Caution is also needed in interpreting the seasonal distributions of fish in certain areas in the light of frequency and size of catches. In particular, the areas of the Shelf to the north of Banquereau and in Sydney Bight received poorer coverage in spring than at other seasons because of the difficulty in fishing in ice. The disposition of fishing stations occupied during the surveys is given in Fig. 2 for the same time periods as in the fish distributions. They should be referred to where necessary in order to avoid absence of catches being interpreted as absence of fish instead of being an artefact of limited survey coverage.

Comparison of distributions in the 1970-74 (Scott 1976) and 1975-79 periods shows that there was little change in distribution or density of the fishes. Unless specifically noted, therefore, comparisons between the 1975-79 period and the 1980-84 period also apply between the 1970-74 and 1980-84 periods.

GROUNDFISH DISTRIBUTION

A brief account of the distribution of the more common groundfish captured during research cruises is given below. Besides the fishes described, many less common species were captured, but so infrequently and in such small numbers that it was not possible to show their distribution. Also, considerable catches of pelagic and meso-pelagic species were made, including herring, gaspereau, mackerel and myctophids. The bottom trawl is not suited for surveying the distribution of species that spend much of their time in mid or surface waters and these species are not considered here.

Descriptions, illustrations and accounts of the biology of each of the species described are given by Scott and Scott (1988).

Alligator fish (Aspidophoroides monopterygius) (Fig. 3)

Catches were sparsely distributed mainly over the eastern part of the Scotian Shelf and in the Bay of Fundy and Browns Bank areas. The trawl is probably not very effective in capturing these small (length up to 18 cm) slender fish and the catch data may not give a reliable picture of their distribution.

The fish was more common in catches in the 1980-84 period than in previous periods, particularly on Browns Bank and in the Bay of Fundy. Catches were made further into the Bay of Fundy and on to the top of Browns Bank in summer and autumn, possibly a reflection of a winter withdrawal to warmer water.

Angler (Lophius americanus) (monk fish, goosefish) (Fig. 4)

The angler was widely distributed over the Scotian Shelf at all depths and along the edge of the Laurentian Channel, but less common in the Bay of Fundy. It appears to avoid cold water on top of the banks in the Browns- LaHave area, and over and to the north of Banquereau. The angler was seldom caught in large numbers but large specimens are common and high catch weights usually represent a few large specimens rather than large numbers of fish.

Catches in the 1975-79 period were somewhat fewer in number but relatively larger than in 1980-84. They were widely distributed at all depths in summer and autumn, but largely off the Banks and out of the Bay of Fundy in spring.

Argentine, Atlantic (Argentina silus) (Fig. 5)

Distribution is mainly limited to deep water (128 m; >70 fath) of the continental slope, Scotian Gulf and the Fundian Channel. Smaller fish tend to frequent shallower water; larger fish, deeper water. Largest catches were made to the southwest of Browns Bank but the fish is distributed in a narrow band as far east as the continental slope south of Banquereau. The fish presumably prefers the warmer, stable temperatures characteristic of the deeper waters it frequents on the Shelf slope.

There was a higher concentration of catches in the deep water of the Scotian Gulf in 1980-84 than in 1975-79 but, otherwise, the distributions were similar. There was no evidence of seasonal variation.

Barndoor skate (Raja laevis) (Fig. 6)

This species was uncommon in catches. It occurred from the Bay of Fundy to the Laurentian Channel, generally in depths less than 183 m (100 fath), but catches were insufficient to indicate any preference for depth, temperature or area.

Catches, usually single fish, were slightly more frequent in 1975-79 than in 1980-84 but were too few for geographic or seasonal comparisons of distribution or biomass to be made. Problems with the comparative rarity of the fish are aggravated by difficulty in identification and confusion with winter skate.

Cod, Atlantic (Gadus morhua) (Fig. 7)

Cod were widespread in depths less than 183 m (100 fath) but catches were noticeably low in cold-water areas to the north of Banquereau and in the warm waters of the Scotian Gulf. They were concentrated in four principal areas: (1) the edge of the Laurentian Channel, (2) the northern edges of Sable Island and Middle Banks, (3) off the edges of the banks in the Browns-LaHave area, (4) in the Bay of Fundy. These concentrations are consistent with the stocks identified by Kohler (1968) on the basis of commercial landings. The distribution supports Kohler's suggestion that the Sable Island-Middle Bank group may be distinct from the Laurentian Channel group. The Bay of Fundy group appears to be substantial and separate from that of the Browns-LaHave area but Kohler did not identify a Bay of Fundy stock from commercial catch data. The distribution of sets made off southwest Nova Scotia was restricted by rough ground, which may explain the low catch levels between the Bay of Fundy and Browns-LaHave areas, and apparent separation of the cod groups of the two areas.

The summer concentrations on the edge of the Laurentian Channel to the east of Cape Breton and northeast of Banquereau are presumably part of the stock complex that overwinters on the eastern offshore banks (Templeman 1962), but part of the complex obviously remains on the Sable Island-Middle Bank area to the northwest of Banquereau, probably as a separate stock from those on the edge of the Laurentian Channel and in coastal waters of Nova Scotia.

The distribution in relation to bottom temperature indicates that cod avoid the warm (10-12°C) waters in the Emerald and LaHave basins and along the edge of the Scotian Shelf, and also avoid the cold (<2°C) water overlying the shallower parts of the area to the north of Banquereau. Best catches were mostly in 4-6°C water along the edge of the Laurentian Channel and in deep waters (>183 m; >100 fath) north of Middle Bank and Banquereau.

Summer distributions were similar in the two 5-yr periods but there were higher concentrations on the northeast Shelf and in the Bay of Fundy in the 1980-84 period. In autumn, there was an apparent withdrawal from the Bay of Fundy into the Fundian Channel and a concentration on Middle Bank, where fall spawning is known to occur (Gagné and O'Boyle 1984). In spring, the fish tended to be off the top of the Banks in deeper (warmer) water.

Common grenadier (Nezumia bairdi) (Fig. 8)

Catches were restricted to the deeper water of the continental slope, the edge of the Laurentian Channel and the Fundian Channel. No large catches were made and the fish is so small in the areas fished that the distribution is shown in terms of numbers caught, rather than weights. The distribution suggests that depth determines the occurrence of the fish. Its initial absence from the Scotian Gulf may be due to the relatively shallow (146 m; 80 fath) area between the deeper parts of the Gulf and the edge of the continental shelf.

Catches were small and few with no evidence of long-term or seasonal change.

Cusk (Brosme brosme) (Fig. 9)

This species was not found on the extreme eastern part of the Scotian Shelf but was generally confined to depths greater than 91 m (50 fath) in the southwestern area of the Shelf and the edge of the Fundian Channel. This distribution suggests that they favor warm water at moderate depths, as described by Oldham (1972), and avoid the shallow water of the banks. Previous analysis (Scott 1971) indicates best catches are taken in 183-274 m (100-150 fath).

There was little difference in summer distribution between the 1975-79 and the 1930-84 periods. The former showed higher individual catches on the whole, particularly on the central Shelf and in the Bay of Fundy. Autumn distribution was similar to summer while in spring the fish were off the top of the banks, particularly in the Scotian Gulf, Fundian Channel and along the edge of the Shelf.

Haddock (Melanogrammus aeglefinus) (Fig. 10)

Three distinct areas of haddock concentration were indicated by catch data: (1) west of Nova Scotia at the mouth of the Bay of Fundy; (2) the Browns-LaHave area; (3) Western Bank. There is the possibility of a fourth group on the western part of Banquereau. The fish was found at depths greater than 183 m (100 fath) but was concentrated on the banks in depths less than 91 m (50 fath) and in deeper water on the edge of the banks. The major part of the Bay of Fundy summer group migrates to overwinter in the Browns-LaHave area as part of the NAFO Division 4X stock. The distribution of research catches is very similar to that of commercial catches (Kohler 1968) but a distinction between the Browns-LaHave and Western Bank stocks is not so sharply defined by the research data as that between the Bay of Fundy group and the Browns-LaHave group.

Haddock appear to avoid the cold water north of Banquereau and prefer the cool water on the banks in the Browns-LaHave area where best catches were made. Their distribution appears to be governed by a combination of depth and temperature, as indicated by McCracken (1965) and, during the summer feeding period, the distribution is presumably determined by the occurrence of the benthic organisms that constitute a large part of the diet.

Summer distributions were similar in the 1975-79 and 1980-84 periods, but catches were higher in all areas in the latter period. This was particularly noticeable on the eastern part of the Shelf where individual catches were as high as to the west. In recent years, the haddock fishery has extended to Banquereau, confirming the increased concentrations of the fish to the east.

Summer and autumn distributions were similar in 1980-84 with some evidence of slightly higher autumn catches along the edge of the Laurentian Channel. In spring the fish were still widespread but concentrations had withdrawn from the Bay of Fundy and off the banks in the central and eastern parts of the Shelf although still concentrated on the Banks in the Browns-LaHave area, possibly for spawning.

Halibut (Hippoglossus hippoglossus) (Fig. 11)

Halibut occurred most frequently in catches in shallow water on the Nova Scotia Banks, but largest individual catches were from the edge of the banks and in deeper water (91-183 m; 50-100 fath) on the edge of the Shelf, probably representing single, large fish. Catches were fairly evenly distributed over the outer half of the Shelf with indication of preference for cool water on the banks but avoidance of the colder water of the Banquereau area and the deeper, warm water of the Scotian Gulf.

Summer distributions in the two periods under review were similar but with increased catches in the Gully between Sable Island and Banquereau. Autumn distribution was similar to summer but in spring the fish had moved off the top of the Banks to deeper water along the edges of the Banks and the Shelf break.

Hookear sculpin (Artediellus uncinatus) (Fig. 12)

This fish was relatively uncommon in catches, probably because of its small size (up to 10 cm in length). Its distribution was similar to that of the alligatorfish - sparsely distributed, mainly on the eastern part of the Shelf but also occurring in the Browns-LaHave area and the Bay of Fundy. It tends to favor intermediate depths between 91 and 183 m (50 and 100 fath). It is probably more common than its recorded occurrence suggests, but is not vulnerable to the otter trawl.

In the 1975-79 period, the few catches were virtually limited to the northeast Shelf but in 1980-84 they were more widespread, similar to the 1970-74 distribution (Scott 1976). Seasonally, the only obvious change was an apparent autumn concentration of the fish in the Bay of Fundy.

Little skate (Raja erinacea) (Fig. 13)

This species has very limited distribution, being concentrated in the Bay of Fundy and Browns Bank areas and to a lesser degree on Sable Island Bank. Catches were not large and occurred over a wide depth range. Although the distribution given is correct, in general, there may be minor errors, as it is extremely difficult to distinguish female little skate from winter skate below about 50 cm in length, and misidentification may affect the distributional picture to some degree.

There was little long-term or seasonal change in distribution but catches were considerably higher in spring and autumn than in summer in the Browns Bank and Bay of Fundy areas.

Longfin hake (Urophycis chesteri) (Fig. 14)

Catches of longfin hake were nowhere great in terms of weight but catches often consisted of small specimens only, and the fish was caught in considerable numbers in certain areas. The fish is mainly confined to the deeper water (>183 m; >100 fath) of the continental slope, edge of the Laurentian Channel, and in the Gully to the east of Sable Island Bank, but not in the Scotian Gulf to any extent except in autumn. Although their distribution extended as far west as the Gulf of Maine, they appear to be more common in the eastern part of the area surveyed.

There were no long-term or seasonal changes in distribution but catches were considerably greater in 1980-84 than in 1975-79.

Longhorn sculpin (Myoxocephalus octodecemspinosus) (Fig. 15)

Distribution was generally restricted to the shallow waters of the Scotian Shelf and the Bay of Fundy with greatest concentrations on Sable Island Bank. It is one of the more abundant of the non-commercial fishes and occasional heavy catches occurred that reflect large numbers of this moderately small (mostly <35 cm in length) fish. The distribution appears to be determined mainly by depth as the fish showed no significant seasonal changes in distribution.

Lumpfish (Cyclopterus lumpus) (Fig. 16)

This species appeared only occasionally in catches. There was no particular pattern in the distribution to indicate preference for depth or temperature. Most lumpfish were captured on the eastern part of the Scotian Shelf, but they are widely distributed in coastal waters all along the Canadian Atlantic coast (Leim and Scott 1966).

Catches were too few and small to show changes in distribution or abundance.

Mailed sculpin (Triglops murrayi) (Fig. 17)

This small species (length up to 20 cm) was widespread in moderate depths (91-183 m; 50-100 fath) over the whole of the Scotian Shelf. Catches were concentrated more towards the eastern part of the Shelf than to the west, although the fish was not uncommon in the Browns-LaHave area and also occurred in Bay of Fundy catches. It appears to favor the slopes of the banks rather than the shallow water on the banks. It was not caught in the warm, deep waters of the Scotian Gulf or Fundian Channel but did occur in cool, deep waters north of Banquereau, suggesting that its occurrence may be related to temperature rather than depth. Considering the fish's small size, its frequent occurrence in the catches suggests that it is abundant on the Scotian Shelf.

There were no obvious long-term or seasonal changes in distribution but catches were greater in 1980-84 than in 1975-79. There was an indication of a withdrawal from the Bay of Fundy in spring.

Ocean pout (Macrozoarces americanus) (Fig. 18)

Distribution of ocean pout was sporadic with most catches in the Bay of Fundy and on Western and Sable Island Banks of Central Shelf . The fish was notably absent from catches on the eastern and western parts of the Scotian Shelf except for infrequent small catches on Browns Bank and to the north of Banquereau. It appears to favor shallow water but was also found in deeper water along the edge of the banks. Previous estimates of abundance (Scott 1971) support the preference for shallow water, with best catches being taken in less than 91 m (50 fath).

There were no long-term changes in distribution or overall abundance.

Plaice, American (Hippoglossoides platessoides) (Fig. 19)

The plaice was among the most widely distributed of the groundfishes. The distribution shows no strong relationship with depth or temperature, but the most noticeable concentrations, on Banquereau, suggest that the fish prefers the cooler temperatures of the eastern part of the Scotian Shelf. Analysis of previous catch data (Scott 1971) indicates that American plaice prefer depths of 91-183 m (50-100 fath) rather than the shallower water on the banks or the deep water on the slope of the continental shelf. The summer catch distribution gives no evidence of separate stocks in the area.

Summer distribution remained unchanged between 1975-79 and 1980-84. Autumn distribution was similar to summer, but heavier spring catches along the edges of Banquereau may indicate a movement to deeper water in winter.

Pollock (Pollachius virens) (Fig. 20)

Although pollock were caught as far east as the Laurentian Channel, the distribution is mainly confined to the Scotian Shelf west of Sable Island with major concentrations off southwest Nova Scotia, in the Bay of Fundy and in the Scotian Gulf. The pollock tends to be associated with mid water rather than the ocean floor (Bigelow and Schroeder 1953) so its occurrence shows less dependence on bottom depth than on temperature. This is reflected in its concentration in relatively warm, bottom water of the Scotian Gulf and Fundian Channel. The fish's tendency to spend considerable time off bottom may result in bottom trawl catches giving an unrepresentative picture of its abundance.

Summer distributions were similar for the two 5-yr periods reviewed, although catches were greater in the 1980-84 period on the central Shelf. Seasonal changes were evident in a concentration of high catches to the north of Sable Island in autumn and a reduction in the Bay of Fundy. This process continued with an apparent withdrawal in winter from the Bay of Fundy and from much of the central Shelf to the Shelf edge, as reflected in the spring distribution. The pattern of catches also shows a change in concentrations of pollock from shallow water on Banquereau in summer to deeper water at the Shelf edge and the Laurentian Channel in autumn and winter.

Redfish (Sebastes spp.) (Fig. 21)

It is generally accepted that there are at least two species of redfish in the Scotian shelf-Bay of Fundy area, they are not distinguished in research cruise results and are combined here.

These species were rarely caught in less than 128 m (70 fath) but were concentrated on the edges of the Laurentian and Fundian Channels, the continental slope and in deep-water channels and basins in the Scotian Shelf. Best catches were on the northern edge of LaHave basin, and other major areas of concentration were along the southwest edge of the Laurentian Channel and south of Sable Island Bank. Redfish were uncommon in the shallow water on the banks but were found in fairly shallow water in the Bay of Fundy. The larger fish tend to be found along the edge of the continental shelf, smaller fish in the basins and holes in the Shelf and in the Bay of Fundy.

Sand lance (Ammodytes dubius) (Fig. 22)

Sand lance occurs only in the shallow waters of the banks, seldom in depths exceeding 91 m (50 fath). Its occurrence is localized and large concentrations may not be located by general research surveys. Besides occurring on Sable Island Bank and Banquereau, it is known to be abundant on Emerald Bank, and special surveys have shown it to be at least occasionally abundant on Browns, Western and Middle Banks.

Catches were too few and too small to show any long-term or seasonal change in distribution. There were no catches comparable to those in the Sable Island-Banquereau area in 1970-74 (Scott 1976).

Sea raven (Hemitripterus americanus) (Fig. 23)

The distribution of the sea raven is largely restricted to the Bay of Fundy and to shallow water on the offshore banks from Browns to Banquereau, but with occasional occurrences in deeper water. There is no obvious correspondence between distribution and temperature.

Catches were too few and too small to show long-term or seasonal changes.

Silver hake (Merluccius bilinearis) (Fig. 24)

Summer distribution of silver hake is determined by temperature in relation to depth as the fish move into shallow water to spawn in late summer on Sable Island and Browns Banks. The species has a preferred temperature of 6-8°C and remains in deeper water off the edge of the continental shelf and in Emerald and LaHave basins until the water on the banks warms up sufficiently to provide suitable conditions for spawning. The distribution of silver hake shown in Fig. 24 corresponds with the distribution of bottom temperatures associated with the intrusion of warm water in the Scotian Gulf, over the western and northern parts of Sable Island and Western Banks and in the Fundian Channel, as well as with the warm water on the continental slope (Scott 1976). They avoid the cold waters on the banks in the Browns-LaHave area and north of Banquereau.

Comparison of the 1975-79 and 1980-84 maps shows no real change in geographic range but a heavy concentration in the Sable Island Bank area in 1980-84.

Seasonal changes in distribution were notable (Fig. 24). In summer, the fish were spread mainly over the central part of the Shelf with a concentration to the east and a minor concentration on the edge of Browns Bank. Later in autumn, the concentrations had moved to the northern part of the Shelf, to the Gully area and up into the Bay of Fundy. By spring, the fish were concentrated in the deep water of the Scotian Gulf and along the Shelf edge. They had withdrawn from the Bay of Fundy. These changes conform to the movements of silver hake on the Shelf in relation to spawning and overwintering migrations as described from commercial fishery data.

Smooth skate (Raja senta) (Fig. 25)

This was among the more widely distributed of the skates, occurring in small numbers in catches from most areas and at all depths, with indications of concentrations in the Bay of Fundy, in moderate depths to the east of Sable Island, and along the edge of the Laurentian Channel.

There were no indications of long-term or seasonal changes in distribution or abundance.

Spiny dogfish (Squalus acanthias) (Fig. 26)

The dogfish is associated with warm water and moves over the Scotian Shelf area and into the Bay of Fundy in early summer. It leaves the Bay of Fundy and withdraws to the Shelf edge and Scotian Gulf as the water cools in autumn. The fish may be found in all areas in summer but heaviest catches were mainly in the Fundian Channel and in the Bay of Fundy where it penetrates to the head of the Bay. It is caught commonly in herring weirs, indicating its movement into shallow, inshore waters. It may be more widely distributed than trawl catches indicate if the fish seeks the layers of warm water that may extend to the bottom in localized areas only.

In summer, the pattern of distribution was similar for both periods under review, i.e. along the Bay of Fundy and Fundian Channel. In 1980-84, catches were heavier and showed higher concentrations on the central Shelf and small, but more frequent catches, to the northeast. In autumn, the fish were concentrated in the Bay of Fundy, on Browns Bank and in the deep water basins of the eastern Gulf of Maine. By spring, they had

withdrawn from the Bay of Fundy and were concentrated in the deep water of the Scotian Gulf and along the Shelf edge as far east as Sable Island Bank. There were isolated moderate catches further east to the Laurentian Channel where high bottom temperatures may occur locally (Scott 1976).

Thorny skate (Raja radiata) (Fig. 27)

This is the most abundant of the skates on the Scotian Shelf and was found over the whole Shelf and in the Bay of Fundy. The fish occurs at all depths but most of the larger catches were in less than 183 m (100 fath). The major concentration was in the Banquereau area with small concentrations in the Western and Browns Banks areas, and in the Bay of Fundy. Elsewhere the fish was fairly evenly distributed except for lower concentrations in the Scotian Gulf and off southwest Nova Scotia. There was no conclusive evidence that temperature determined the fish's distribution as it was found in the cold waters north of Banquereau as well as in the warm waters of the Scotian Gulf, Fundian Channel and on the continental slope. The concentration in the northeast Scotian Shelf area and comparatively poor catches in the Scotian Gulf, however, suggest a preference for cool temperatures.

The distributions showed no evidence of long-term or seasonal changes.

White hake (Urophycis tenuis) (Fig. 28)

There is a persistent problem in distinguishing the closely associated red hake (Urophycis chuss) from white hake. For this reason, the two species are combined here as white hake. This tends to bias the distribution towards the shallower depths and warmer water occupied by red hake.

Although widespread at all depths over the central and western parts of the Scotian Shelf, main concentrations of white hake were in deeper water (91-366 m; 50-200 fath) on the edge of the Laurentian Channel, the mouth of the Bay of Fundy, the Gully, the edges of Emerald and LaHave basins and, to a lesser extent, the edge of the continental shelf. There was no obvious correlation between fish distribution and bottom temperature except that there was avoidance of temperatures below about 3°C, such as occurred to the north of Banquereau and on top of the banks in the Browns-LaHave area.

White hake showed no notable long-term changes in summer distribution although catches in the Bay of Fundy and along the edge of the Laurentian Channel were higher in 1980-84 than in the previous 5-yr period. Autumn distribution was much like summer but with higher concentration in the Bay of Fundy. By spring, the fish had withdrawn from the Bay of Fundy and were concentrated in the deep water of the eastern Gulf of Maine and Scotian Shelf.

Winter flounder (Pseudopleuronectes americanus) (Fig. 29)

This flounder is generally confined to shallow, coastal waters but a presumably discrete and substantial stock exists in the shallows of Sable Island and Western Banks where the fish frequently appears in catches with other flatfish. A smaller group exists on Browns Bank. The only other significant area of occurrence of winter flounder is in the Bay of Fundy where two groups may be identified, one at the mouth of the Bay and the other in the mid-part of the Bay. There is no evidence of temperature preference in the research cruise catches, but inshore populations of the fish are known to migrate to deeper water in winter in the Bay of Fundy.

There were no long-term changes in distribution. Lower catches in the central Bay of Fundy in summer than in autumn and spring may indicate a withdrawal from the area but could be a result of inshore migration (McCracken 1963).

Winter (eyed) skate (Raja ocellata) (Fig. 30)

As noted previously, there is difficulty in distinguishing winter skate from little skate. Winter skate is so much more abundant, however, that misidentification would have little affect on the distribution picture.

The distribution of this species was largely confined to shallow (<91 m; <50 fath) waters of the Scotian Banks and the Bay of Fundy. The distribution was localized, with major concentrations on Banquereau, Sable Island and Western Banks, and smaller concentrations to the west on Browns Bank and in the Bay of Fundy. The distribution suggests a preference for cooler temperatures.

The two summer and the autumn distributions were similar, with main concentrations on the eastern Shelf. In the 1980-84 period, there was a higher concentration of fish in catches at the head of the Bay of Fundy than in the earlier 5-yr period. The most conspicuous change of distribution was in spring where there was a heavy concentration of fish along the Shelf edge south of Banquereau.

Witch flounder (greysole) (Glyptocephalus cynoglossus) (Fig. 31)

This flounder is widely distributed and found at all depths, with increasing abundance to the northeast along the Shelf. It was absent from catches off southwest Nova Scotia, much of the Scotian Gulf, and from most of the shallow waters (<91 m, <50 fath) on the offshore banks, except Banquereau. Best catches were along the edge of the Laurentian Channel and in the Bay of Fundy. The witch has a preference for depths in 183-274 m (100-150 fath) range (Scott 1971), evidently associated with temperatures below about 9°C as it apparently avoids the higher temperatures in the Scotian Gulf, but is common at even the low temperatures associated with the area to the north of Banquereau. Its summer distribution may be governed by factors determining the occurrence of its major prey, polychaete worms and amphipods (Scott 1975) which are associated with mud or mud-sand bottoms (Leim and Scott 1966).

There were no obvious distributional differences between the two summer periods. In autumn, witch had apparently left the top of the Banks on the eastern part of the Shelf and, in spring, it had also withdrawn from the Bay of Fundy and moved into deeper water.

Wolffish, Atlantic (Anarhichas lupus) (Fig. 32)

Distribution of Atlantic wolffish was concentrated on the banks in the Browns-LaHave area and on the edges of the banks in the central part of the Scotian Shelf, with scattered distribution at moderate depths on the northeastern part of the Shelf and in the Bay of Fundy and Gulf of Maine. The fish appears to prefer the cooler temperatures in these areas and was seldom caught in the warmer waters of the Scotian Gulf, Fundian Channel or continental slope. Previous catch data (Scott 1971) indicate that wolffish have a preferred depth range of 50-99 fath.

The only evident change in distribution, either long-term or seasonal, was a reduction in catches in the Bay of Fundy from summer to autumn and a partial recovery in spring.

Yellowtail flounder (Limanda ferruginea) (Fig. 33)

This species was confined to shallow water, generally less than 91 m (50 fath), on the Nova Scotia Banks, with major concentrations on Western, Sable Island, Middle and Banquereau Banks. The only other area showing significant concentrations of yellowtail was Browns Bank. The distribution indicates a preference similar to American plaice for the generally cooler water temperatures and/or sand bottom to the northeast of the Shelf. There are at least two stocks separated by the Scotian Gulf. It is possible that the Gully also constitutes a barrier separating a Banquereau stock from the Sable Island-Western Banks group(s).

Both long-term and seasonal distributions remained similar.

DISCUSSION

Comparison of the 1975-79 and 1980-84 groundfish distributions does not reveal any substantial changes in geographic ranges or stock structure on the Scotian Shelf. There are indications of increased concentrations of several species in some 'new' areas, e.g. haddock on the northeast Shelf, but they appear to be a consequence of increased abundance rather than extension of range. Seasonal changes are evident in many species, however. Typically, these are shown in spring as compared to summer by a withdrawal from the Bay of Fundy and from the shallow water on the Banks to deeper water off the Banks. The spring distribution reflects two factors: movement to deeper, warmer water in winter, and migration to spawning grounds in spring. Conversely, there is the apparent penetration of some areas in spring and withdrawal in autumn. Changes from summer to autumn are much less evident than from spring to summer. Presumably this is because water temperatures on the Banks remain high in summer and autumn but fall in winter and remain comparatively low through spring. Two obvious exceptions to the case of stable summer-autumn distributions are spiny dogfish which makes an early withdrawal from the central Shelf, and silver hake which makes spawning migrations onto the shallows of the central Shelf in late summer and autumn.

ACKNOWLEDGMENTS

I thank Drs. R. G. Halliday and J. D. Neilson for extensive and helpful criticism which has resulted in a more concise and pragmatic presentation than the original draft; J. Gale for computer preparation of the distributional maps; F. Cunningham for help with illustrations; B. Best and J. Hurley for word processing and all the scientific, technical and research vessel staff who, through the years, have managed and served on the research surveys and provided the basic data on which this work is based.

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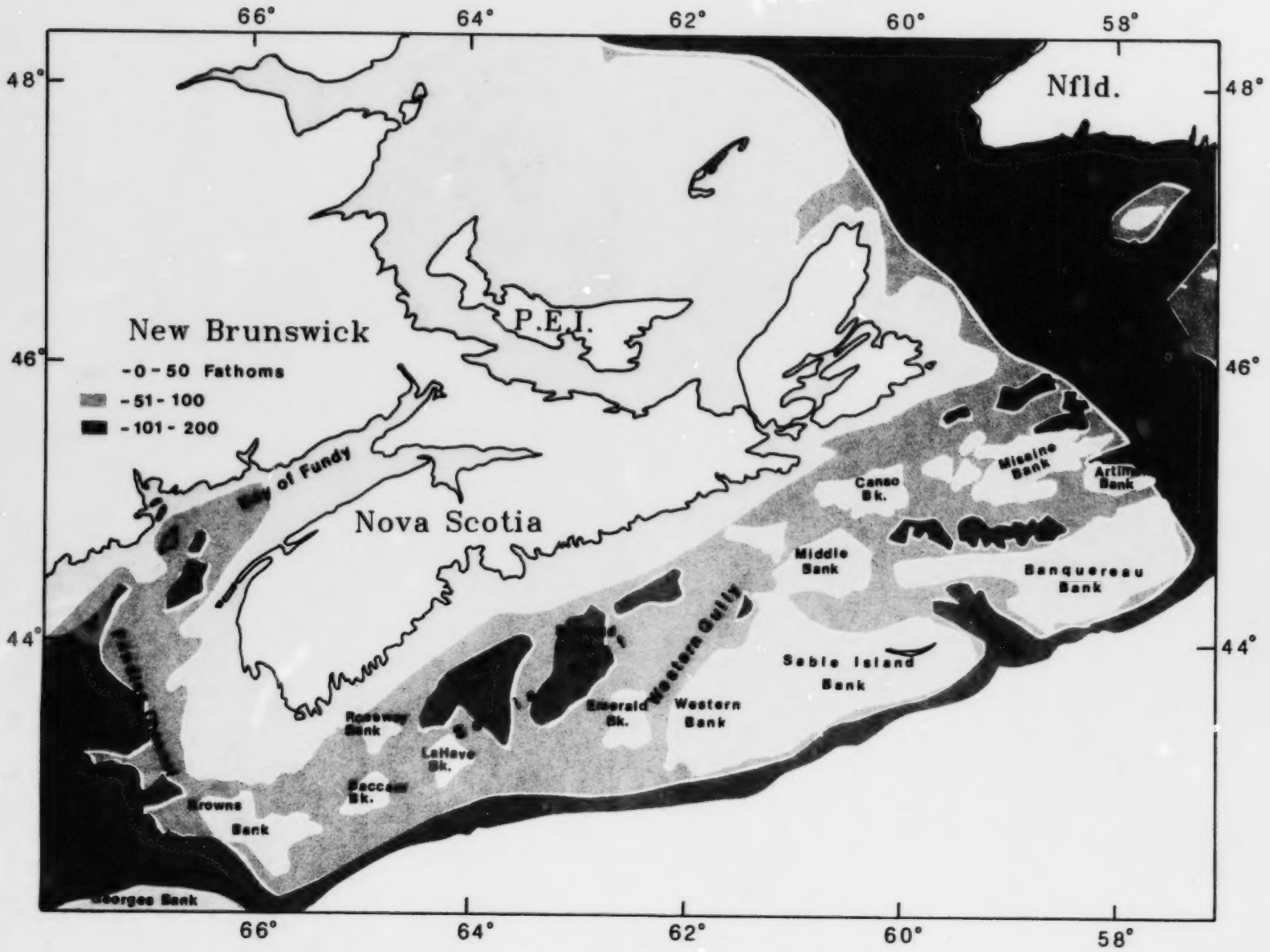


Fig. 1. Scotian Shelf and Bay of Fundy.

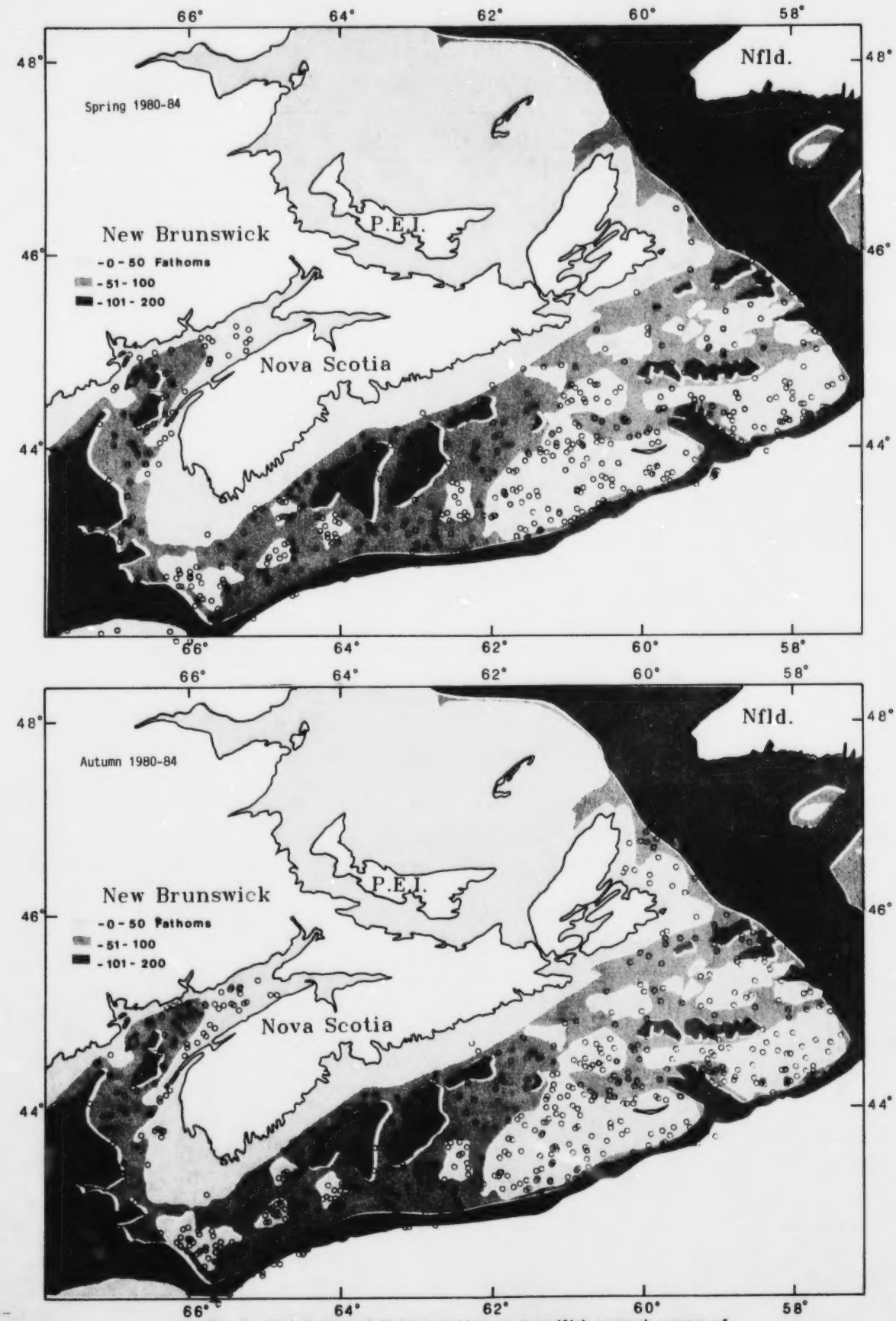
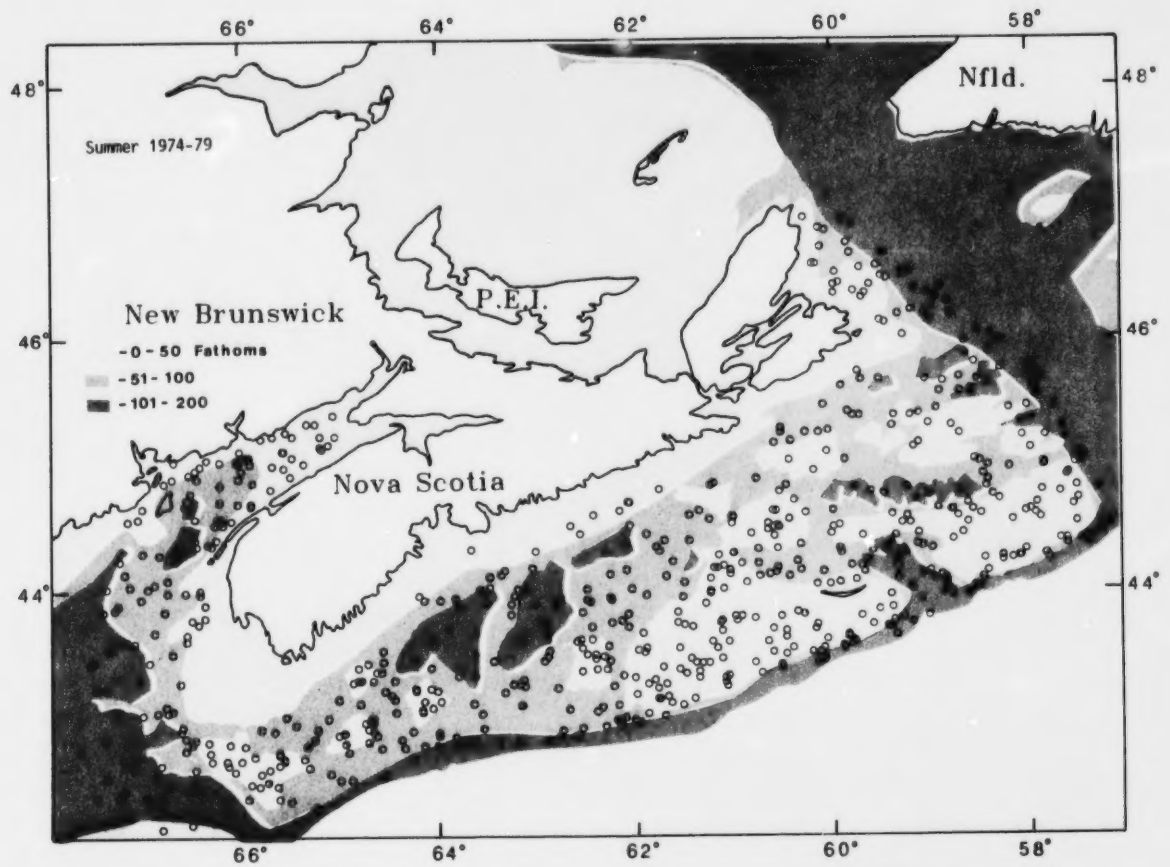


Fig. 2. Distribution of fishing stations on groundfish research surveys of the Scotian Shelf and Bay of Fundy in summer 1975-79 and spring, summer and autumn 1980-84.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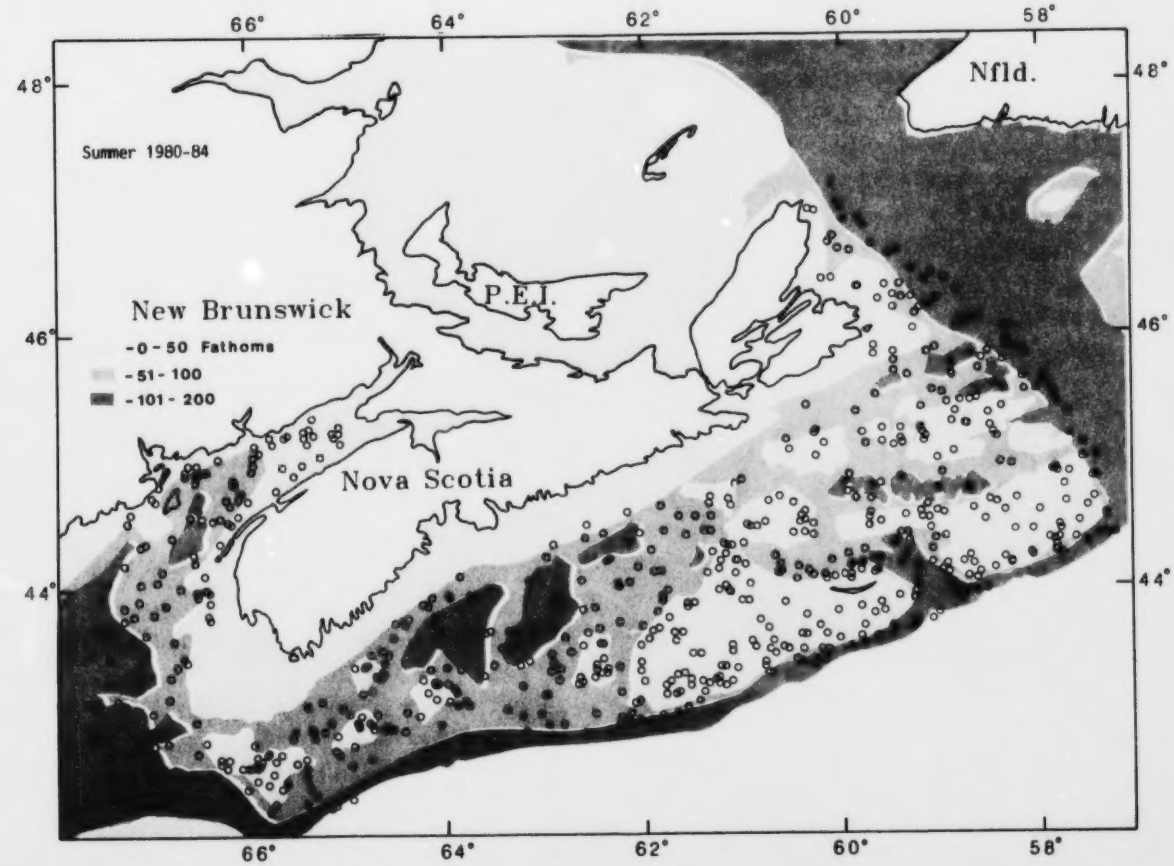
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Nova Scotia

Fig. 3-33. Distributions of groundfishes on the Scotian Shelf and in the Bay of Fundy in summer 1975-79 and spring, summer and autumn 1980-84, from groundfish research surveys, Scotia-Fundy Region.

Fig. 3. Alligatorfish (Aspidophoroides monopterygius)

Fig. 4. Angler (Lophius americanus)

Fig. 5. Argentine, Atlantic (Argentina silus)

Fig. 6. Barndoor skate (Raja laevis)

Fig. 7. Cod, Atlantic (Gadus morhua)

Fig. 8. Common grenadier (Nezumia bairdi)

Fig. 9. Cusk (Brosme brosme)

Fig. 10. Haddock (Melanogrammus aeglefinus)

Fig. 11. Halibut (Hippoglossus hippoglossus)

Fig. 12. Hookear sculpin (Artediellus americanus)

Fig. 13. Little skate (Raja erinacea)

Fig. 14. Longfin hake (Urophycis chesteri)

Fig. 15. Longhorn sculpin (Myoxocephalus octodecemspinosus)

Fig. 16. Lumpfish (Cyclopterus lumpus)

Fig. 17. Mailed sculpin (Triglops murrayi)

Fig. 18. Ocean pout (Macrozoarces americanus)

Fig. 19. Plaice, American (Hippoglossoides platessoides)

Fig. 20. Pollock (Pollachius virens)

Fig. 21. Redfish (Sebastes marinus)

Fig. 22. Sand lance (Ammodytes dubius)

Fig. 23. Sea raven (Hemitripterus americanus)

Fig. 24. Silver hake (Merluccius bilinearis)

Fig. 25. Smooth skate (Raja senta)

Fig. 26 Spiny dogfish (Squalus acanthias)

Fig. 27. Thorny skate (Raja radiata)

Fig. 28. White hake (Urophycis tenuis)

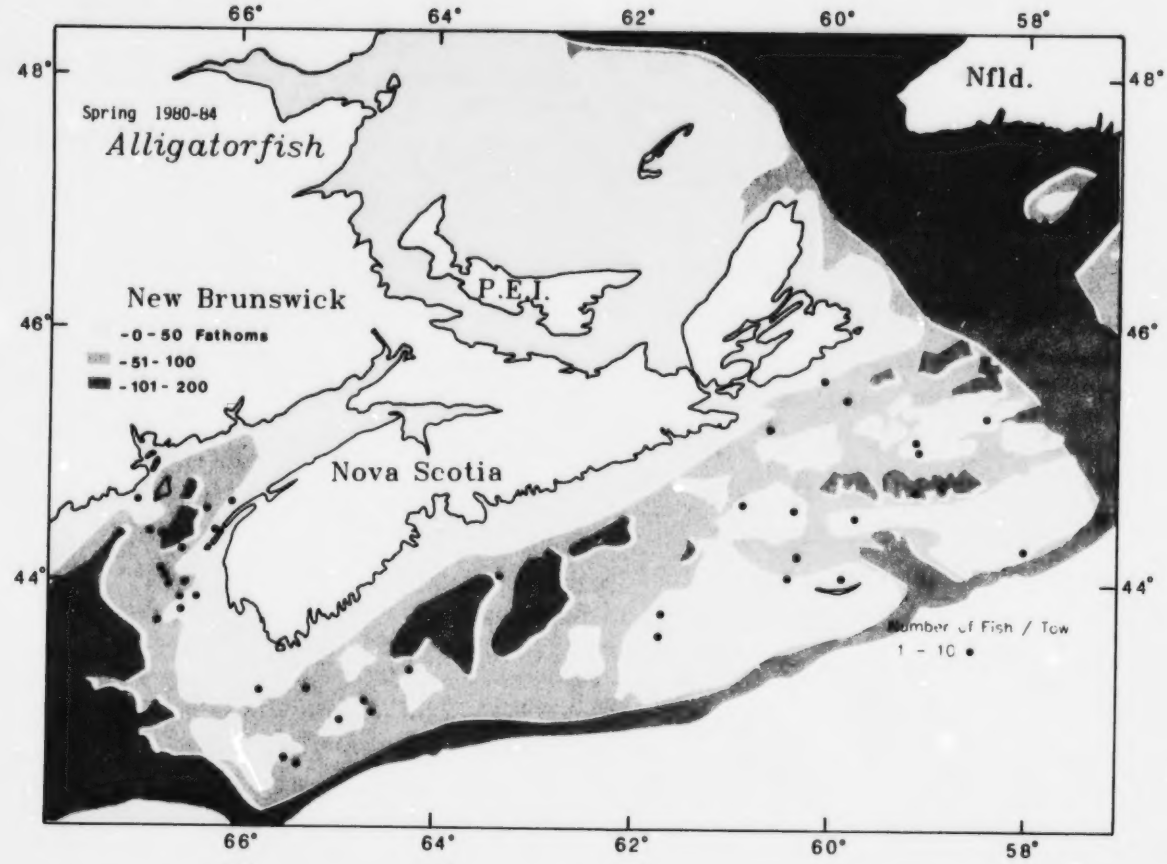
Fig. 29. Winter flounder (Pseudopleuronectes americanus)

Fig. 30. Winter (eyed) skate (Raja ocellata)

Fig. 31. Witch flounder (graysole) (Glyptocephalus cynoplossus)

Fig. 32. Wolffish (Anarhichas lupus)

Fig. 33. Yellowtail flounder (Limanda ferruginea)



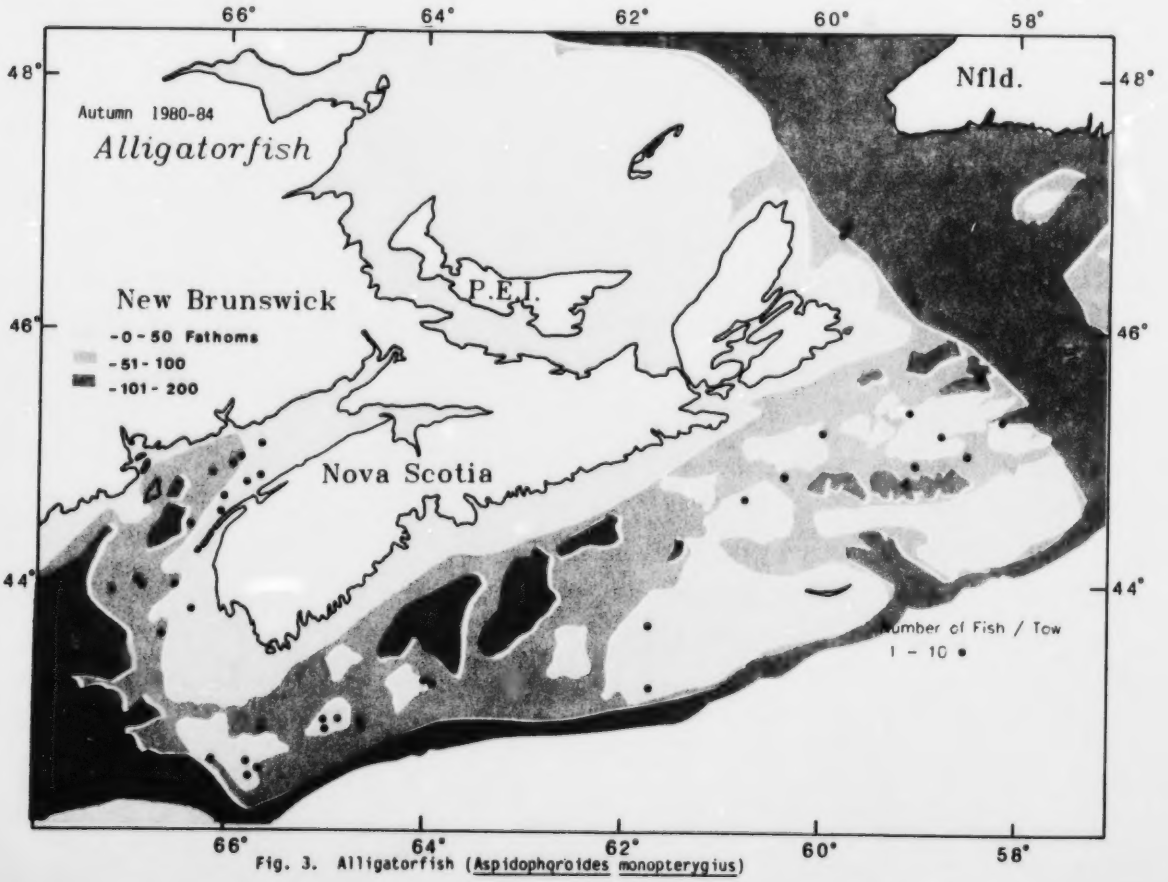
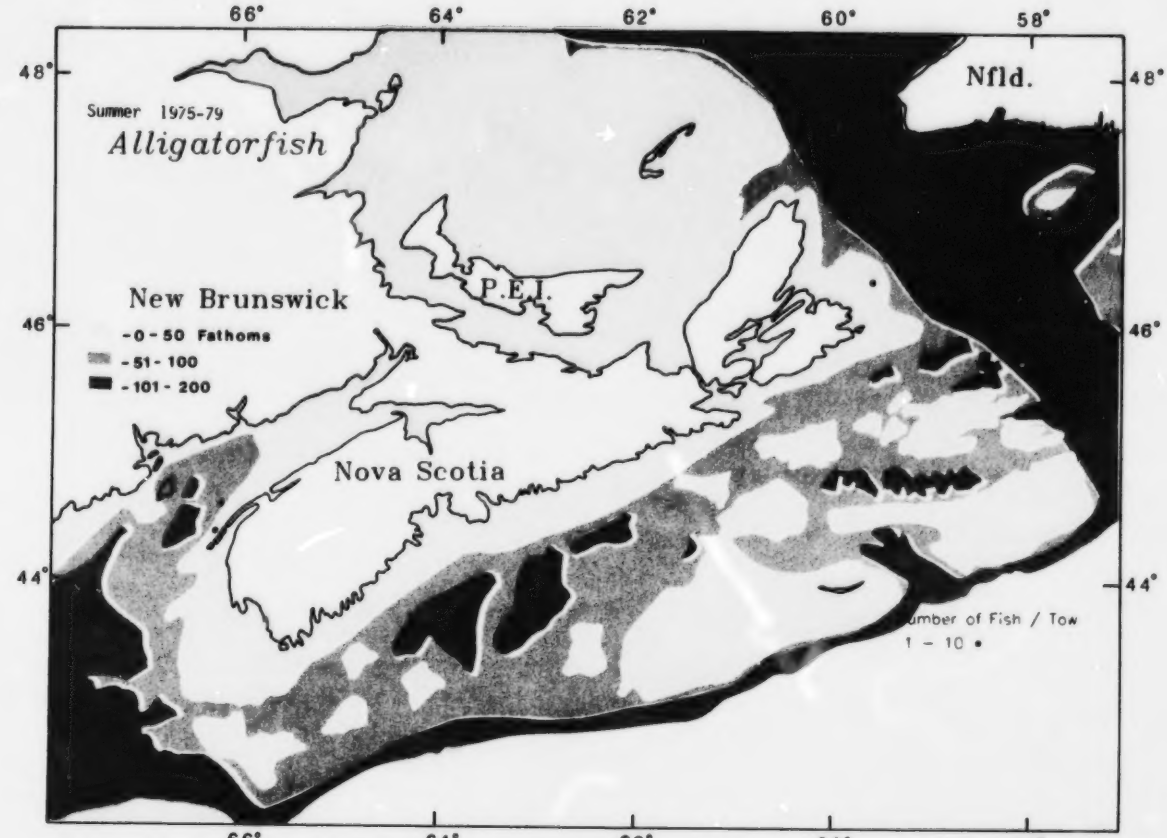


Fig. 3. Alligatorfish (Aspidophoroides monopterygius)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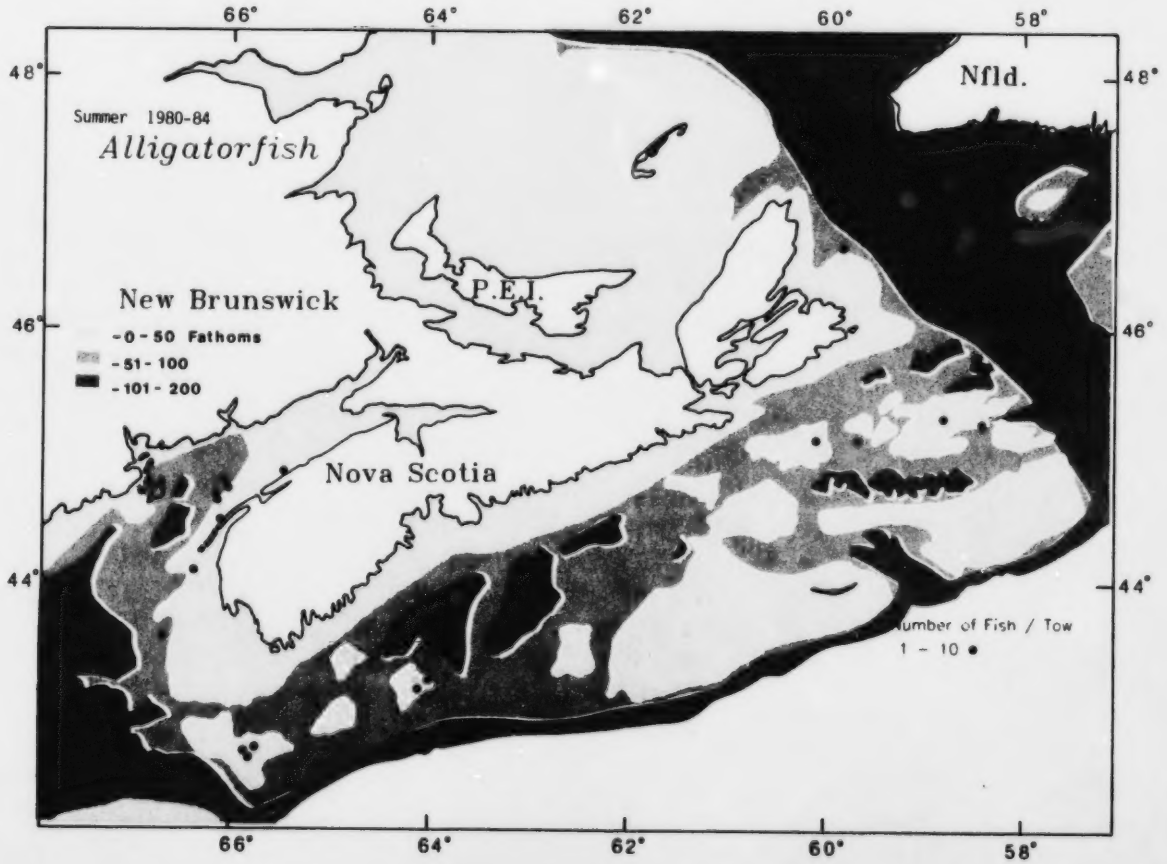
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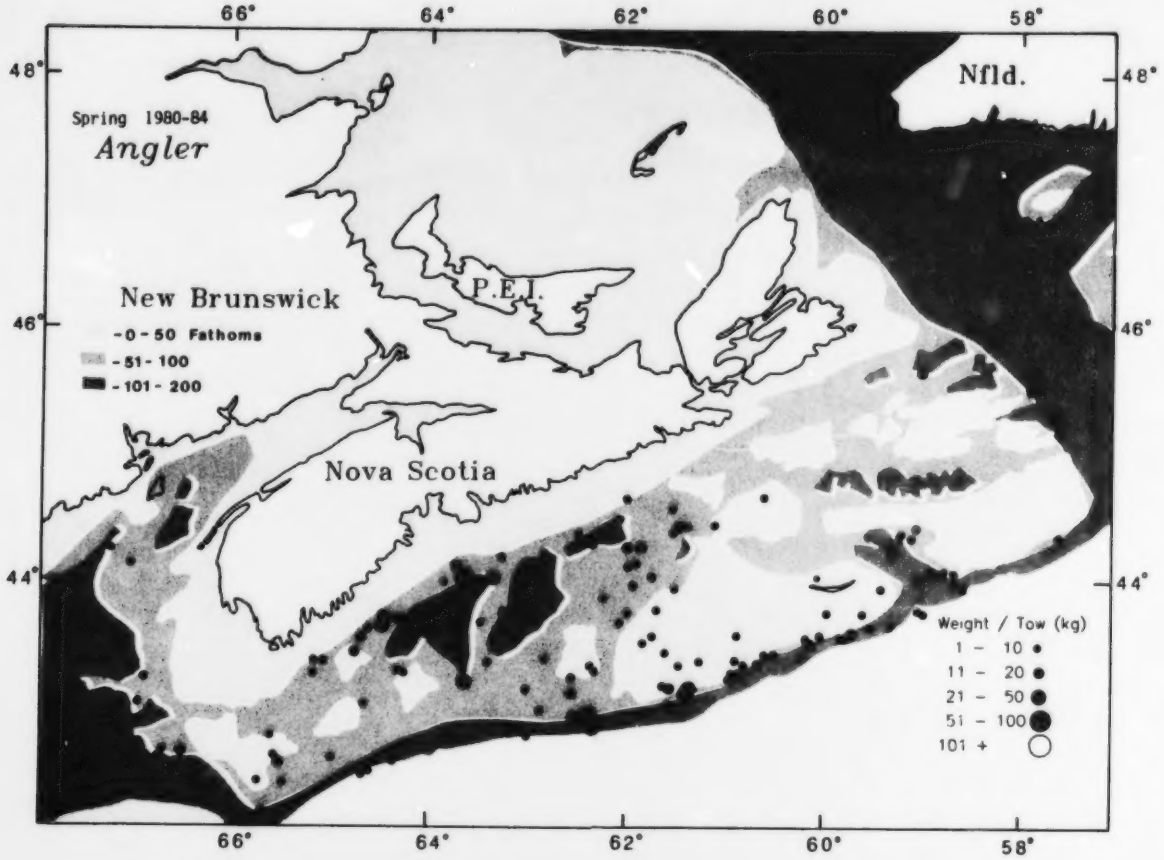


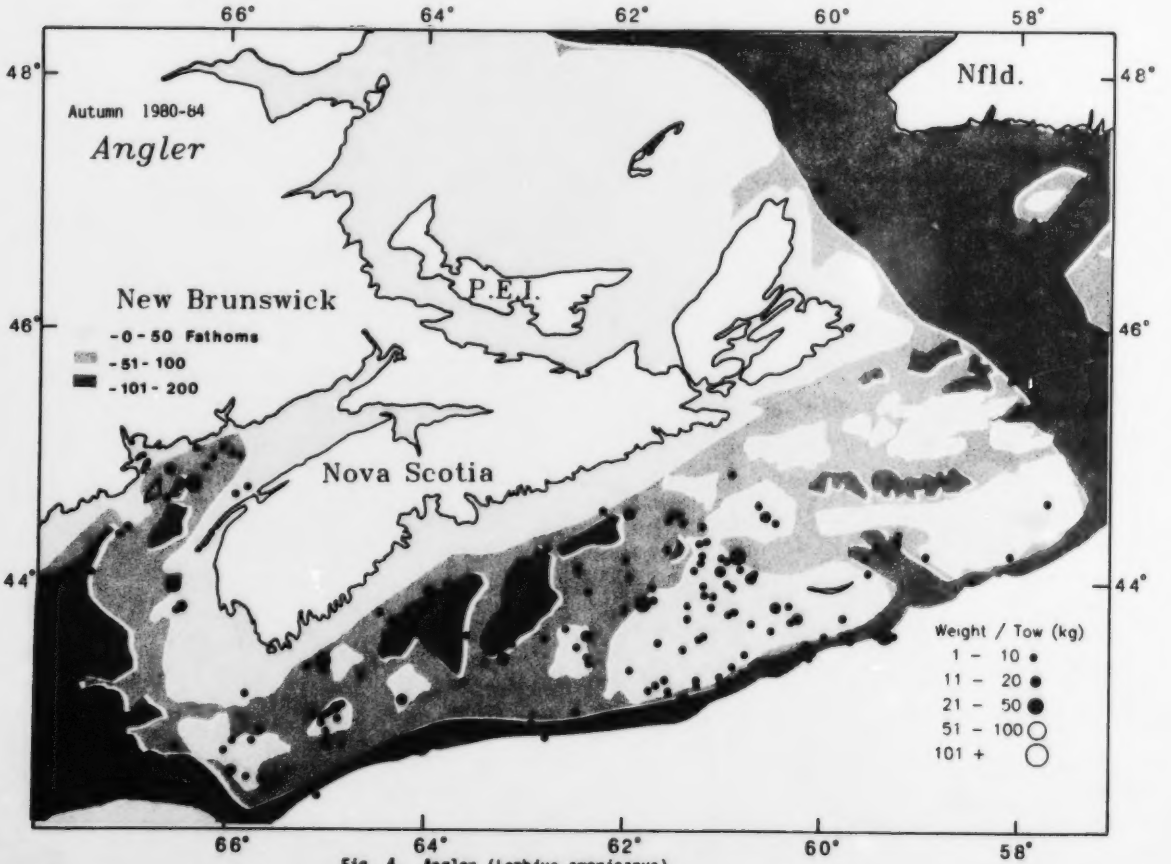
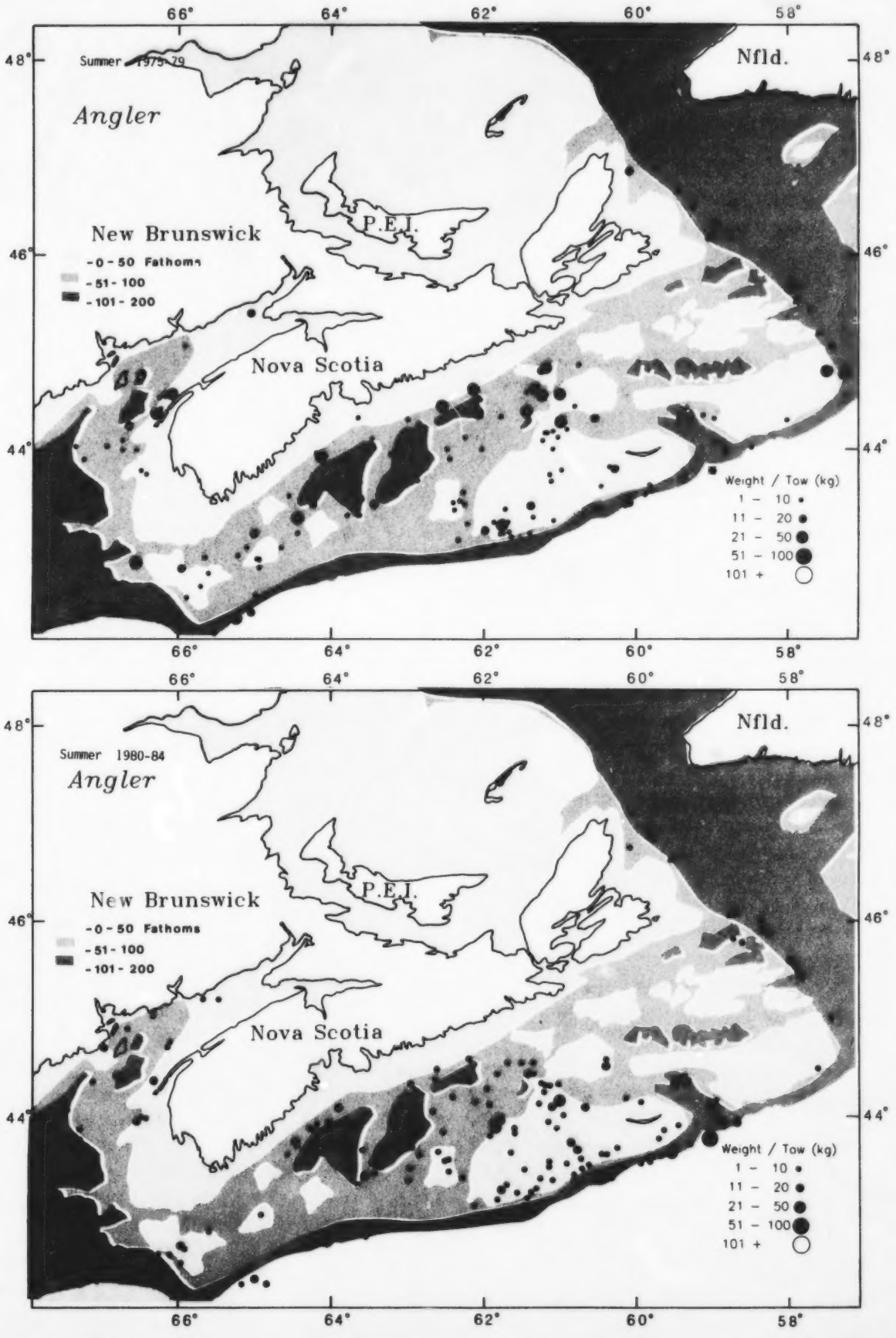


Fig. 4. Angler (Lophius americanus)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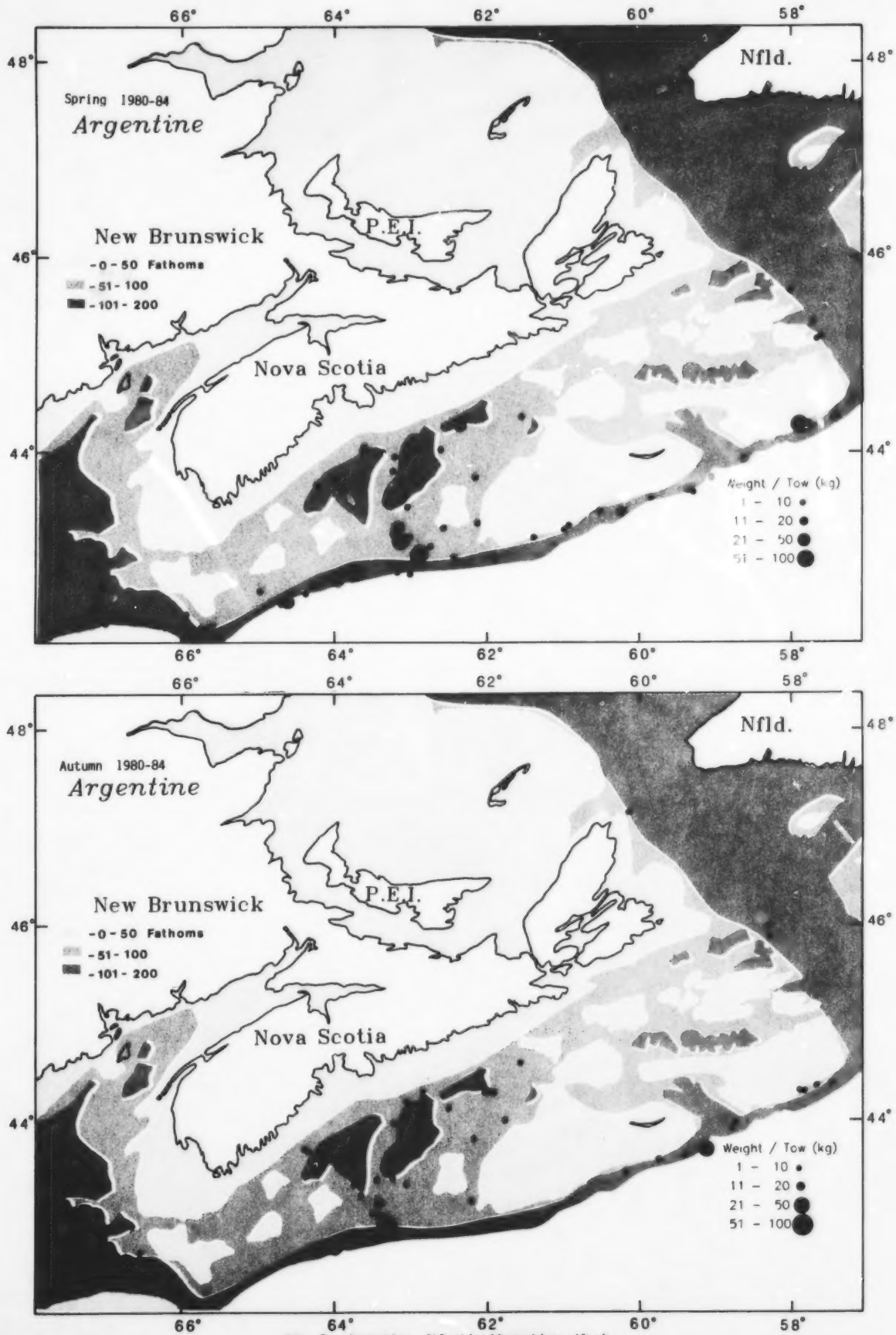
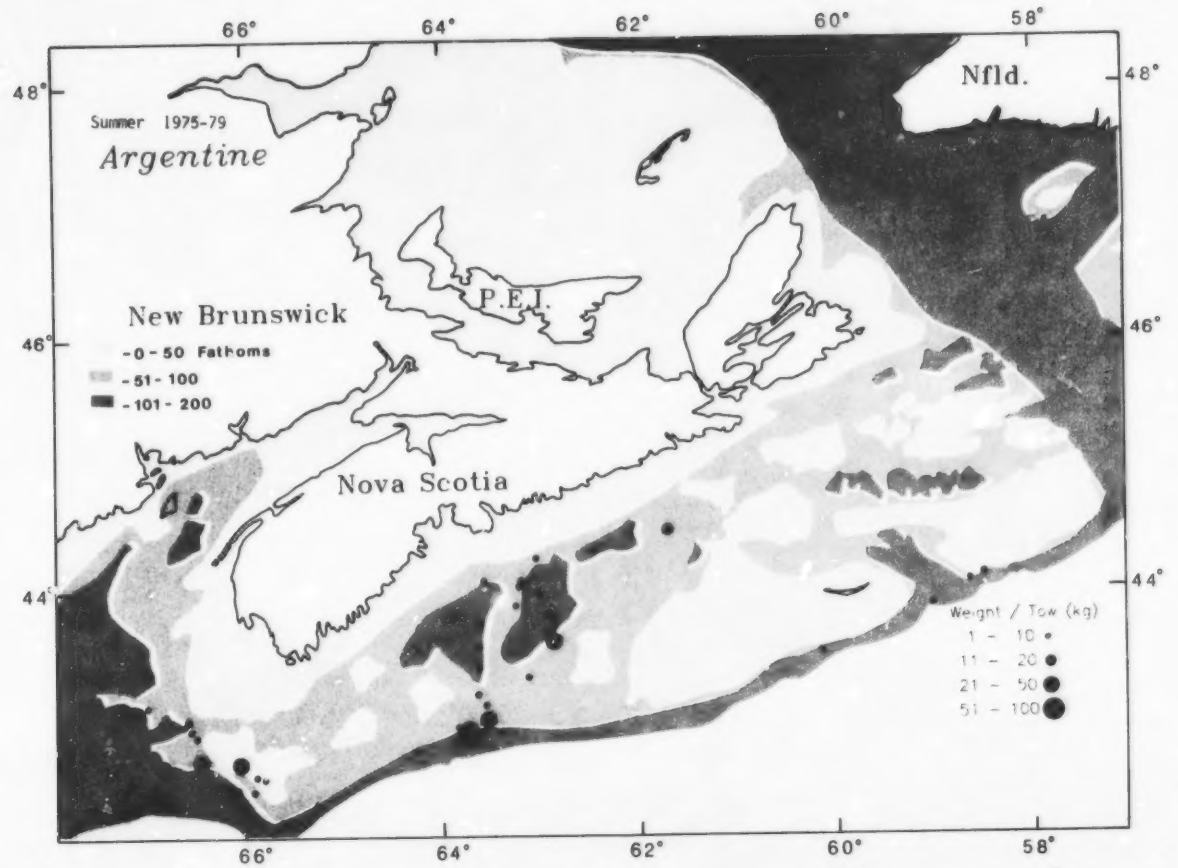


Fig. 5. Argentine, Atlantic (Argentina silus)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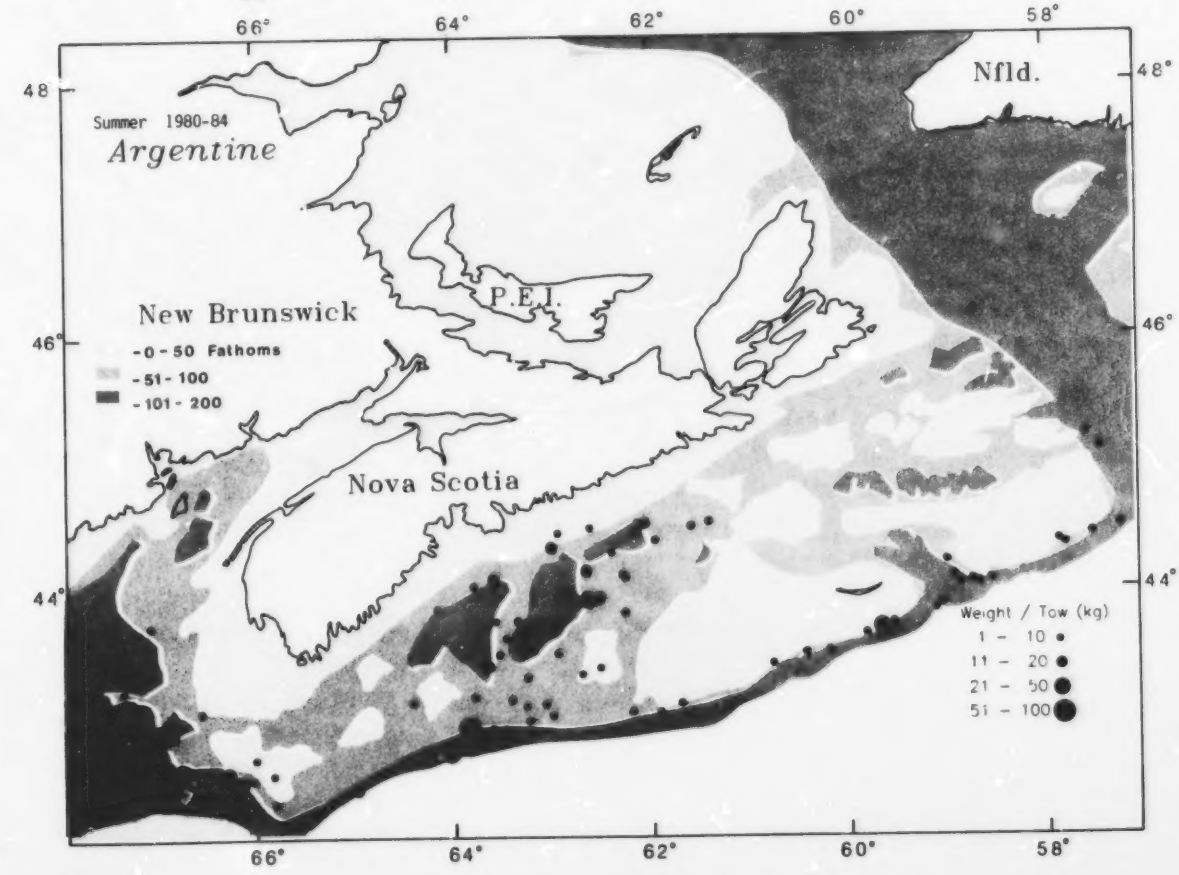
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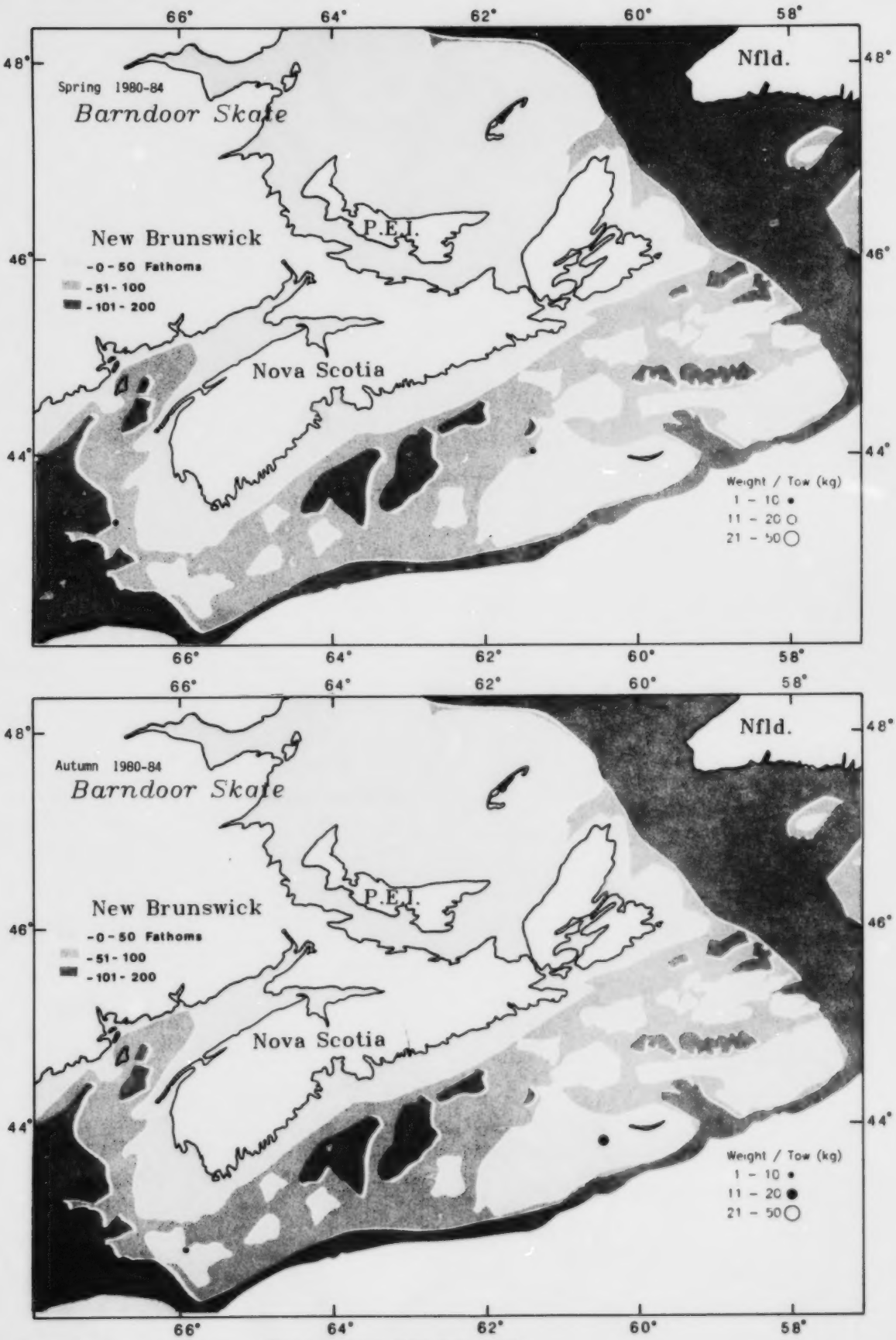
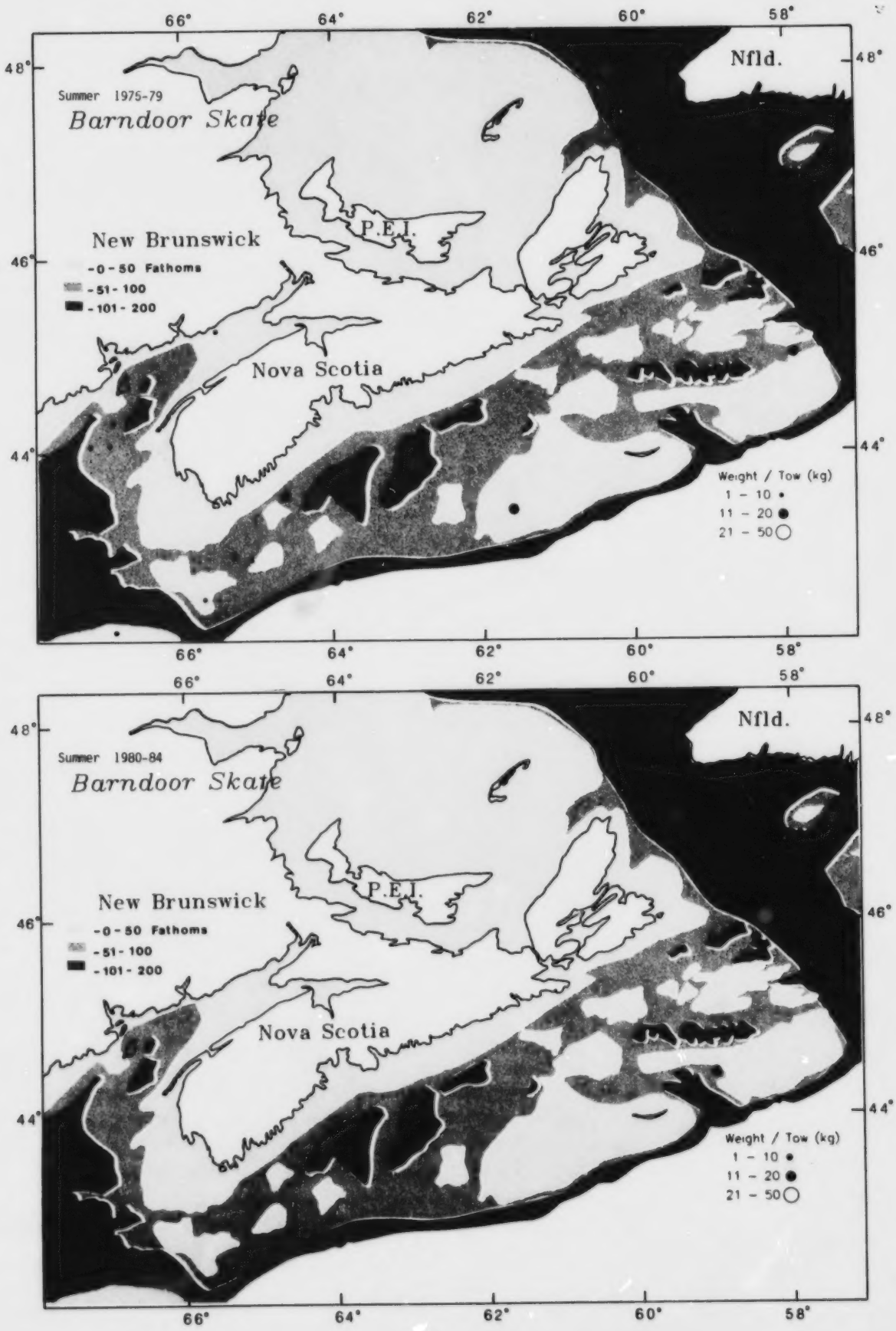


Fig. 6. Barndoor skate (Raja laevis)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Summer 1980-84
Barndoor Skate
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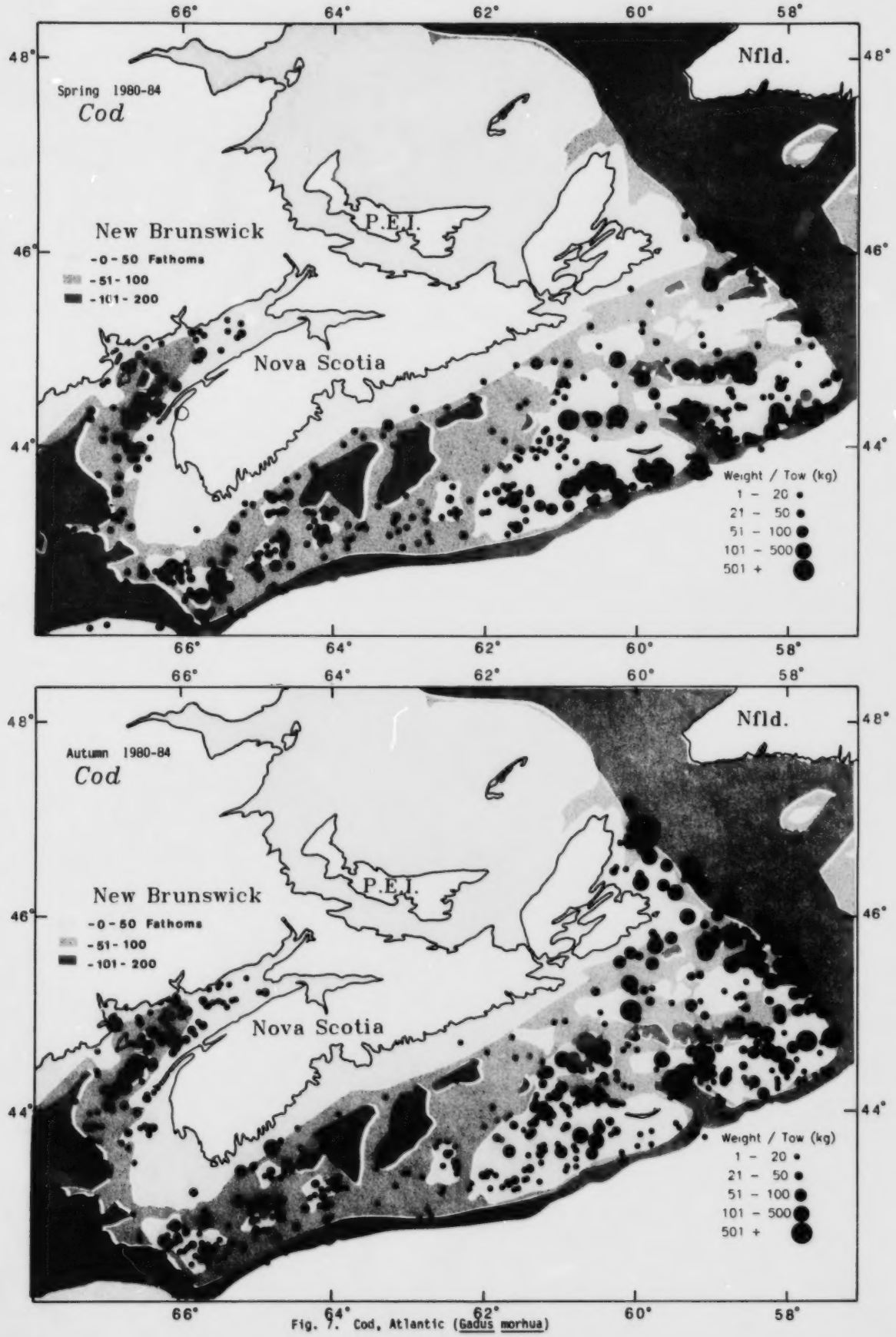
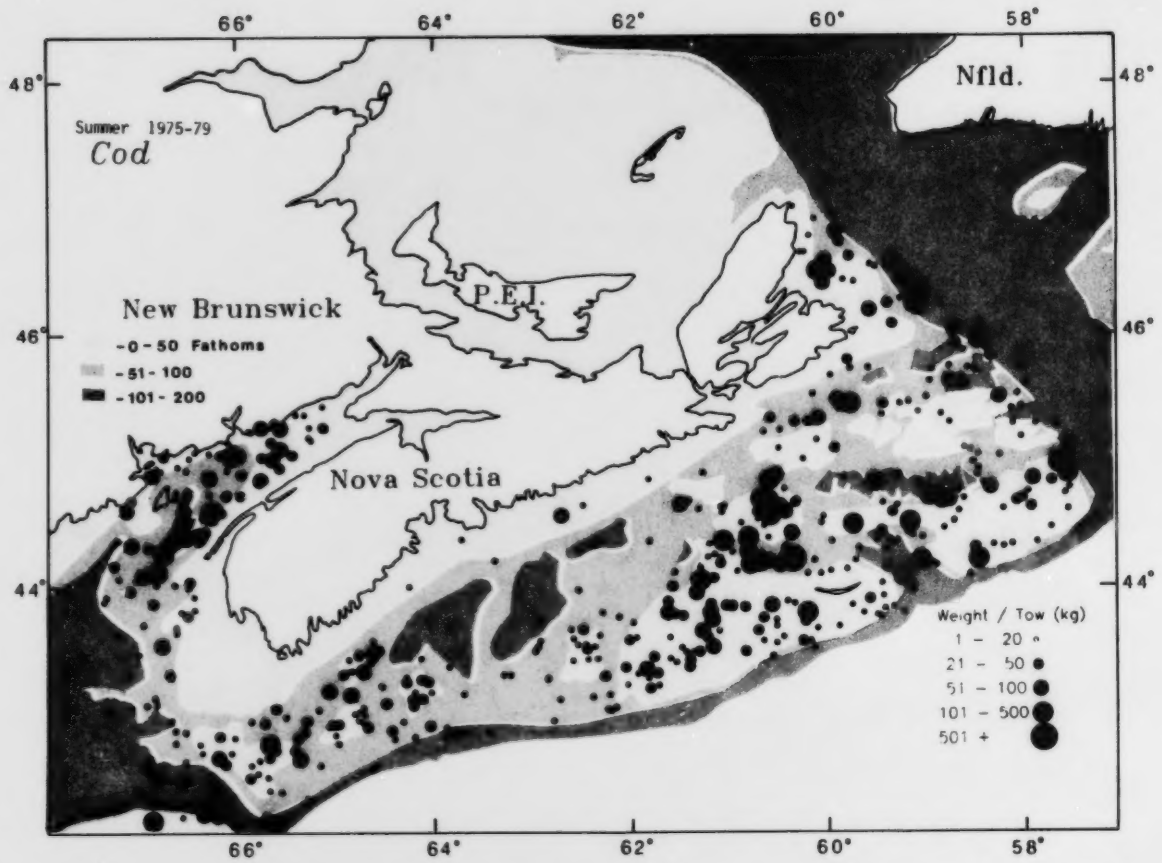


Fig. 7. Cod, Atlantic (Gadus morhua)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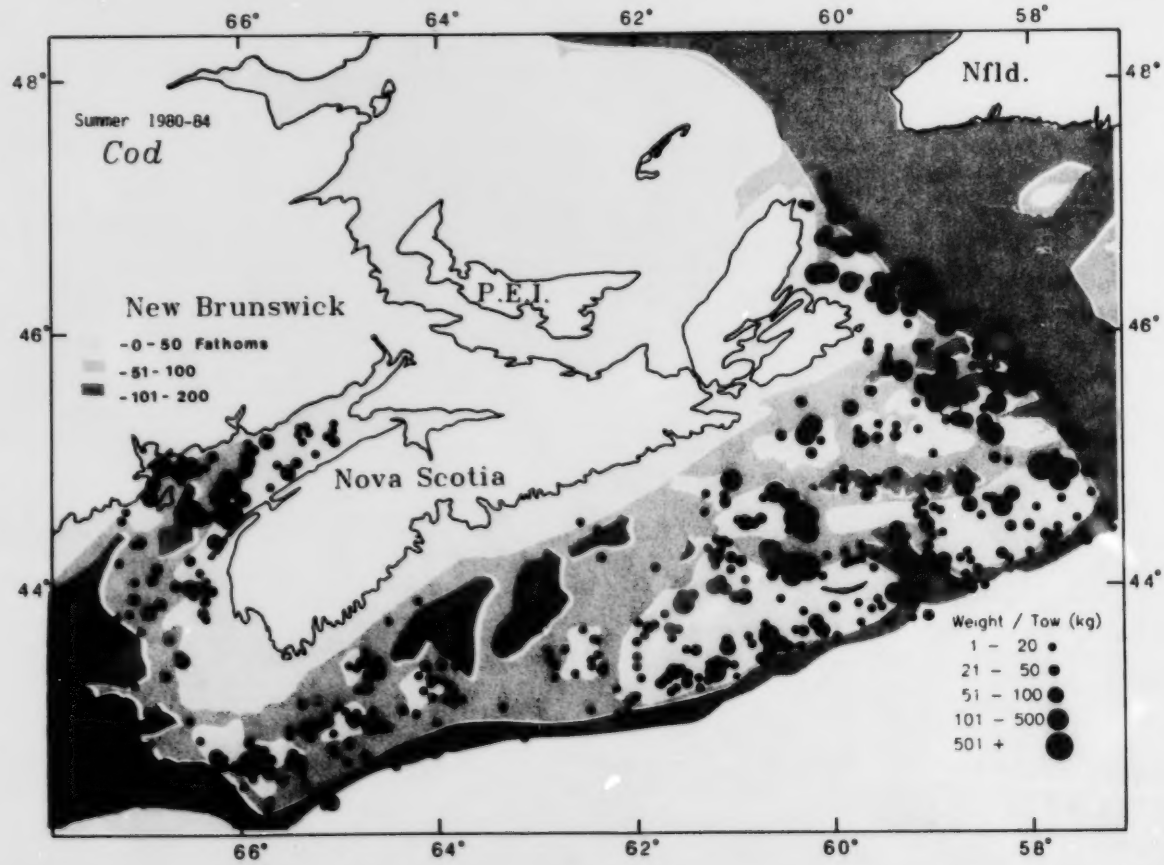
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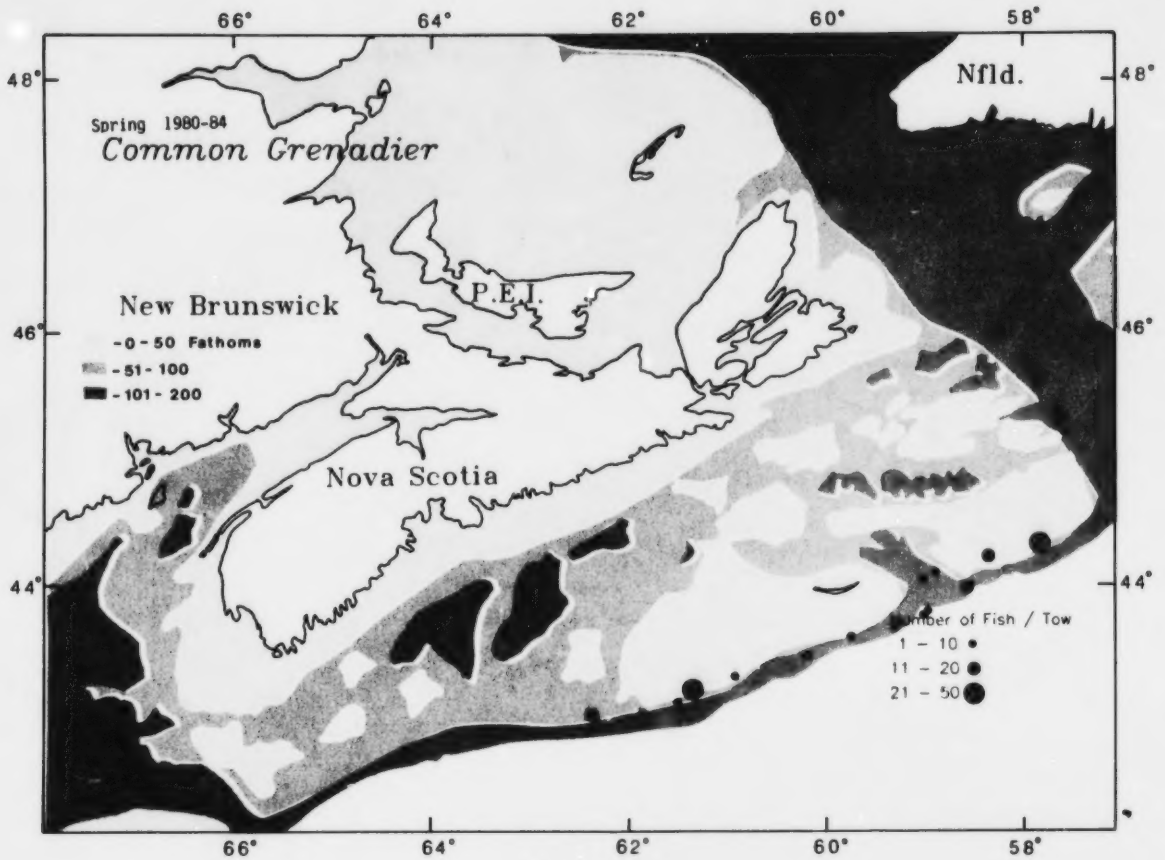


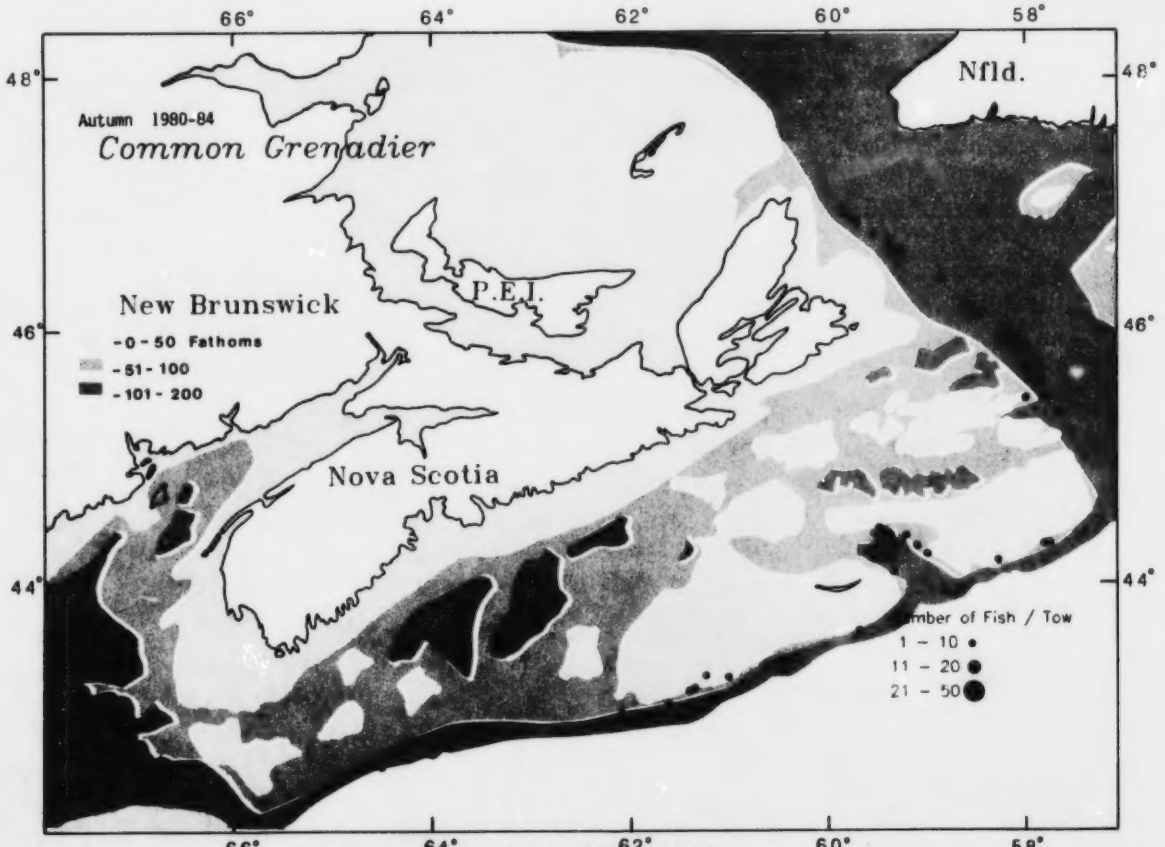
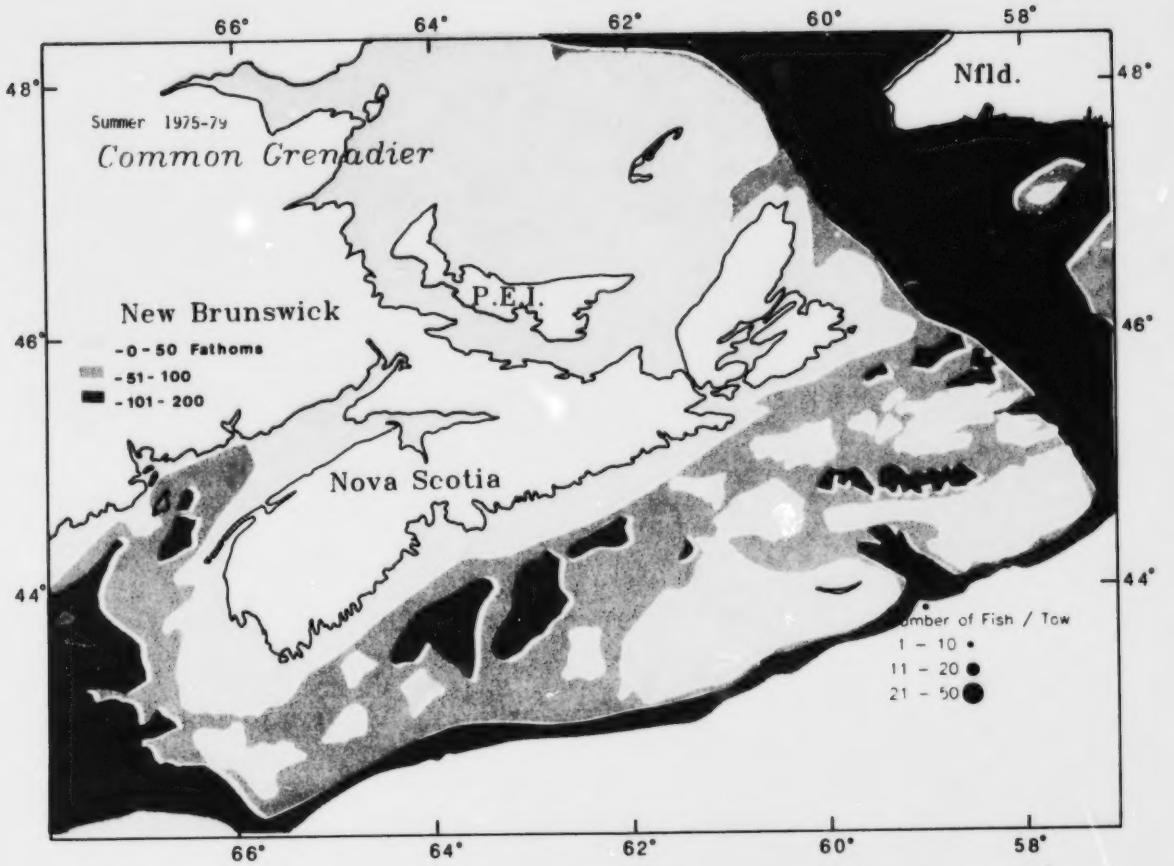
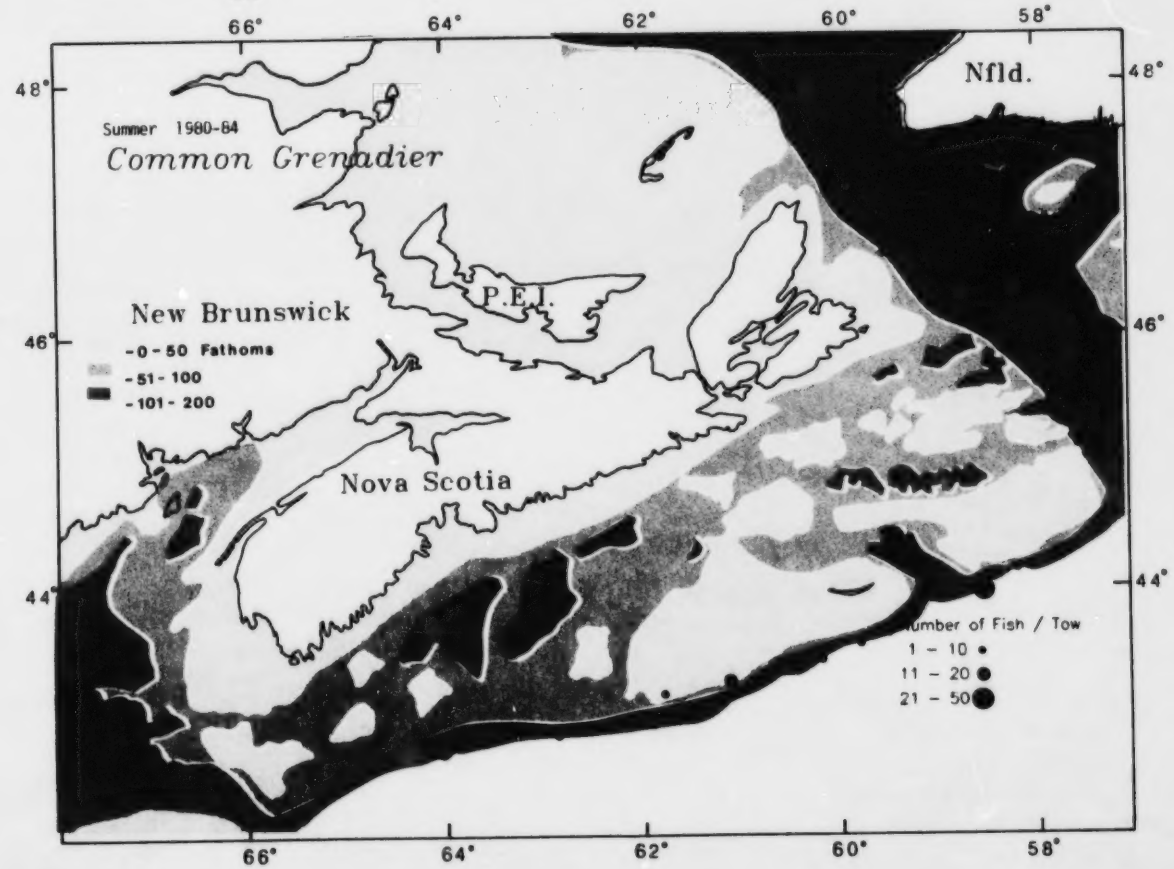
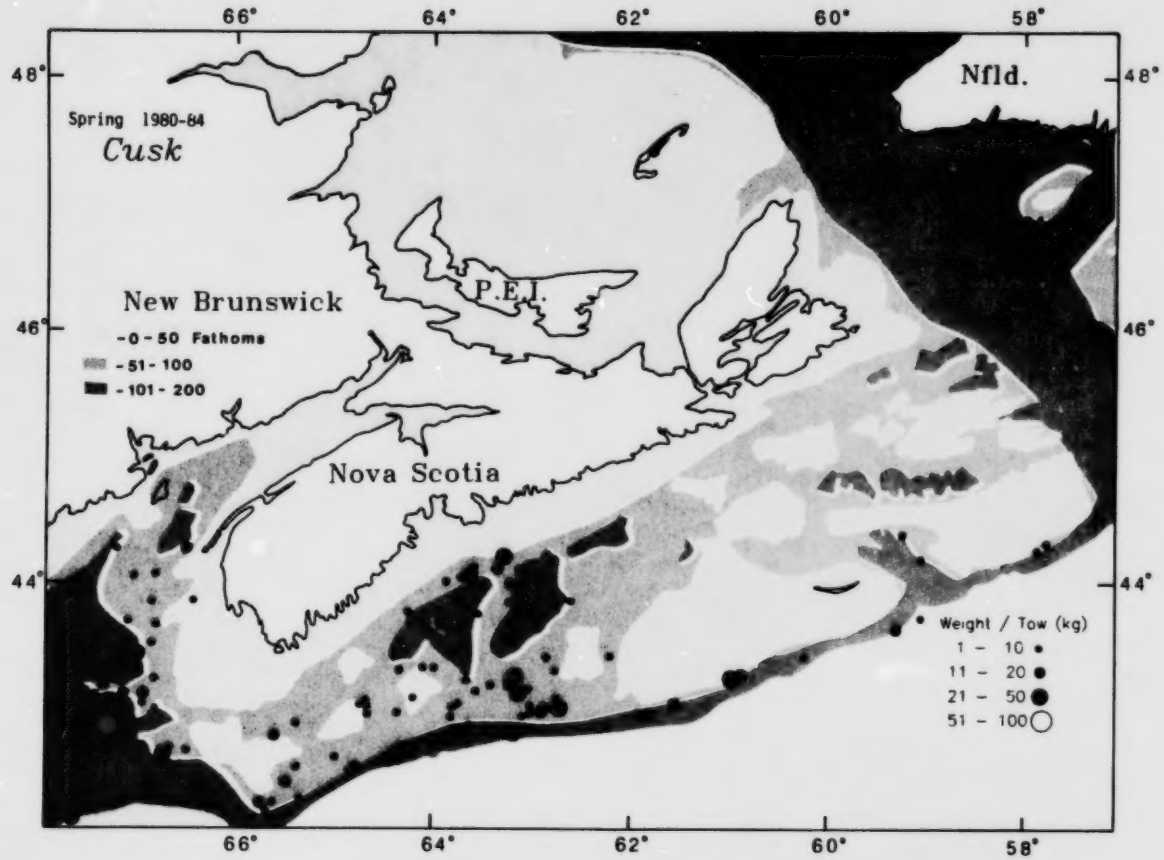


Fig. 8. Common grenadier (Nezumia bairdi)


66°
64°
62°
60°
58°
48°
46°
44°
Nfld.
Summer 1975-79
Common Grenadier
P.E.I.
New Brunswick
-0-50 Fathoms
-51-100
-101-200
Nova Scotia
1 - 10
11 - 20
21 - 50


66°
64°
62°
60°
58°
48°
46°
44°
Nfld.
Summer 1980-84
Common Grenadier
P.E.I.
New Brunswick
-0-50 Fathoms
-51-100
-101-200
Nova Scotia
1 - 10
11 - 20
21 - 50



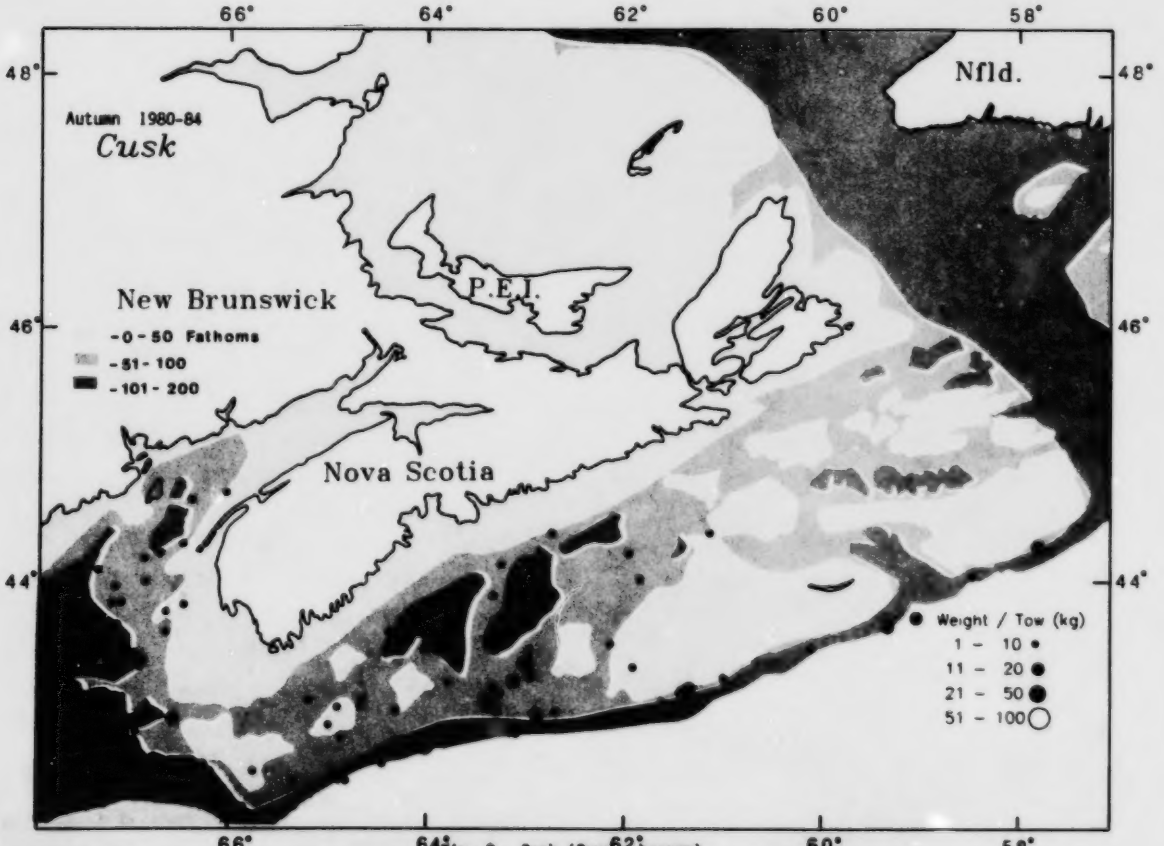
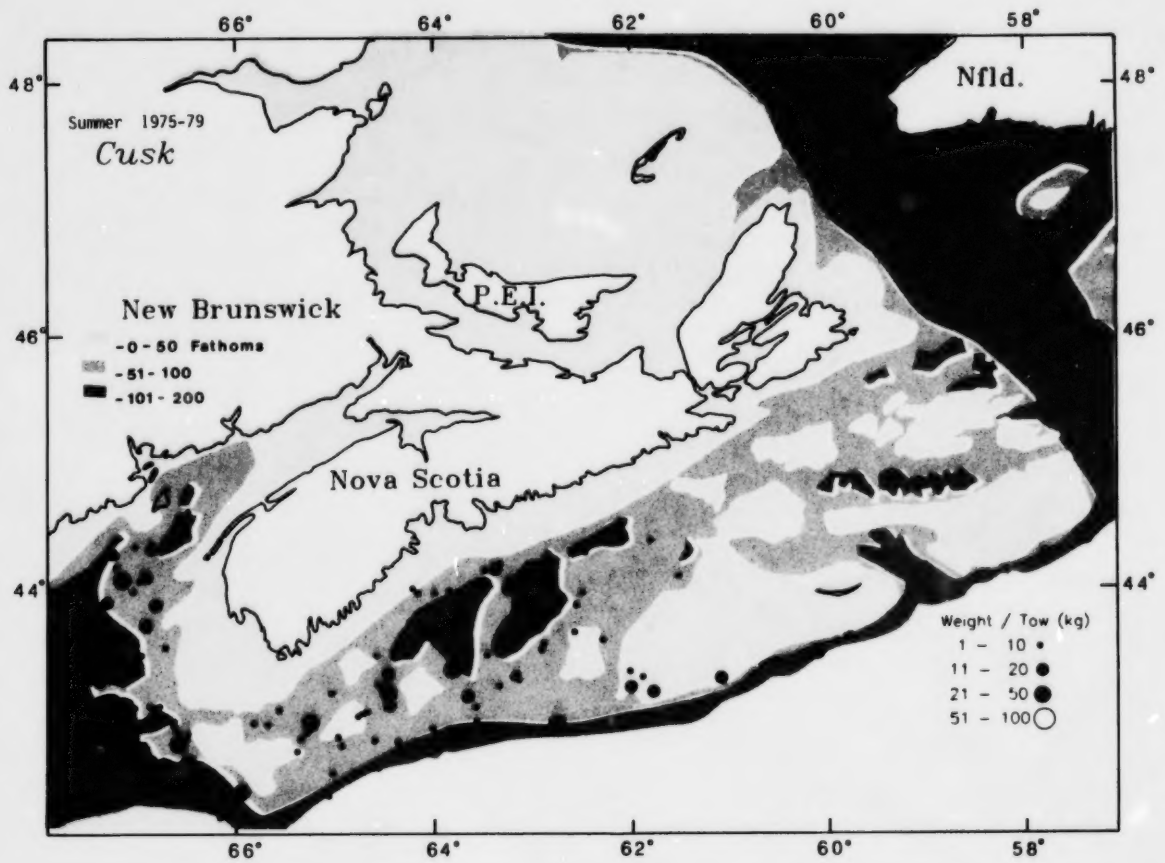
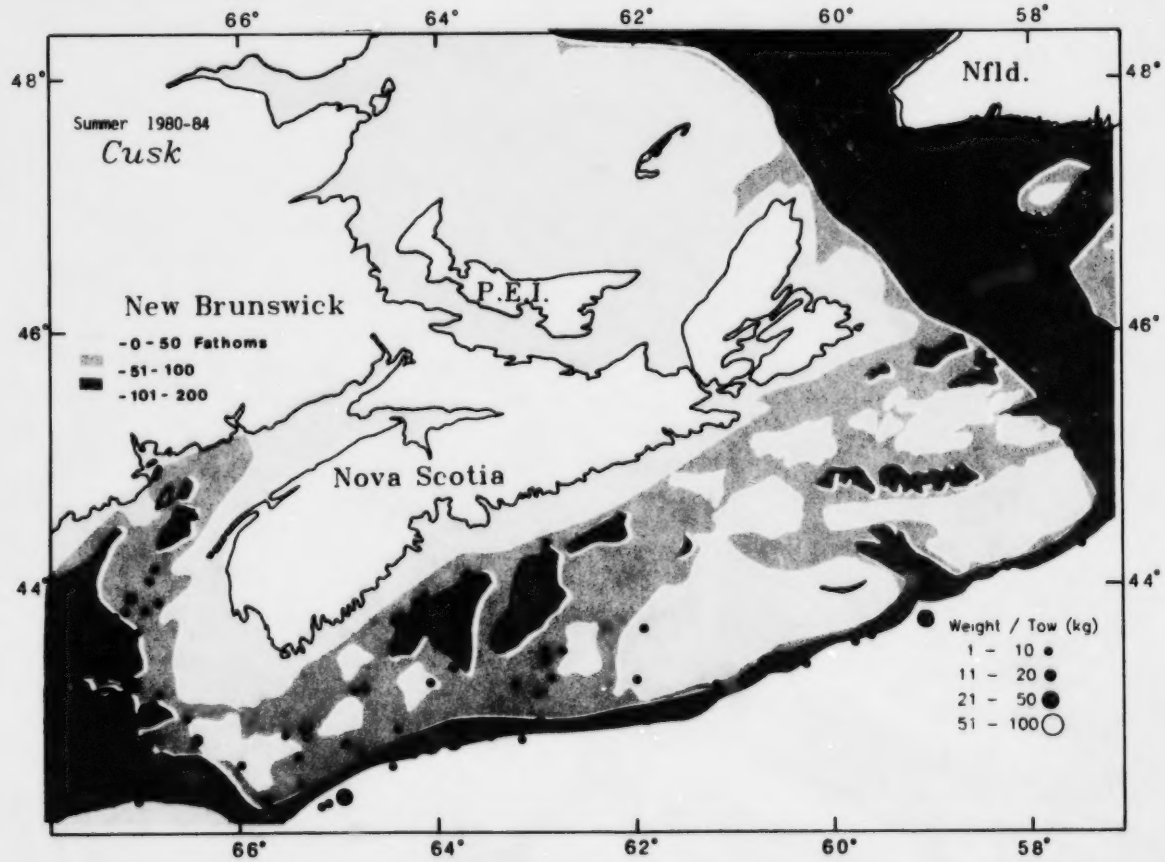
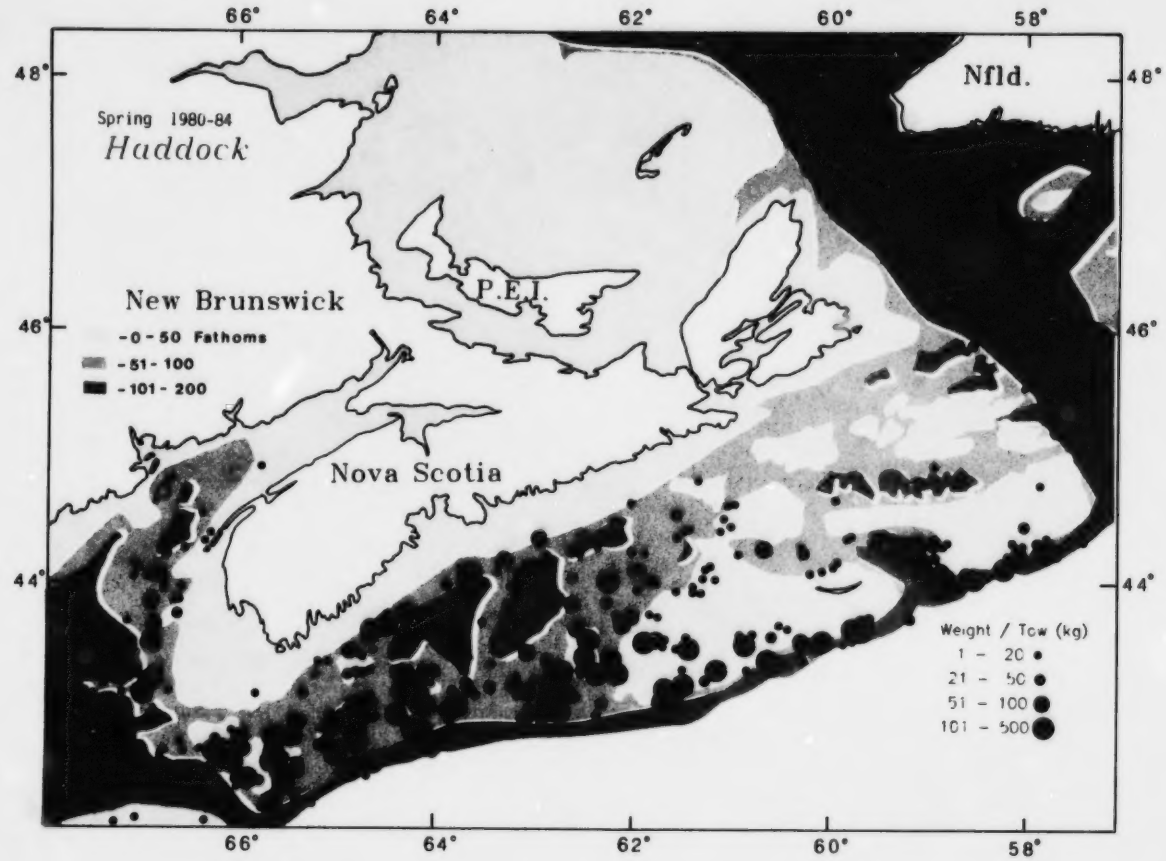


Fig. 9. Cusk (Brosme brosme)


66°
64°
62°
60°
58°
48°
46°
44°
Nfld.
Summer 1975-79
Cusk
New Brunswick
P.E.I.
Nova Scotia
-0-50 Fathoms
-51-100
-101-200
Weight / Tow (kg)
1 - 10
11 - 20
21 - 50
51 - 100


66°
64°
62°
60°
58°
48°
46°
44°
Nfld.
Summer 1980-84
Cusk
New Brunswick
P.E.I.
Nova Scotia
-0-50 Fathoms
-51-100
-101-200
Weight / Tow (kg)
1 - 10
11 - 20
21 - 50
51 - 100



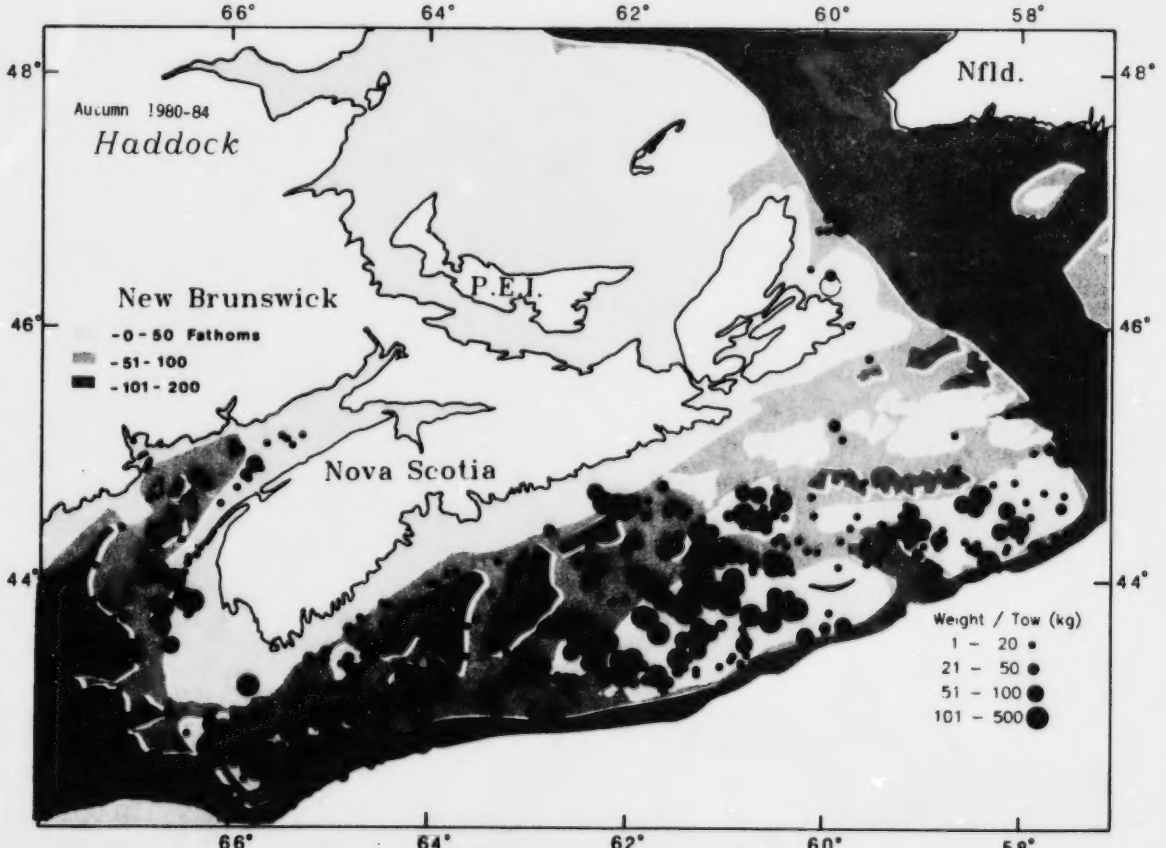
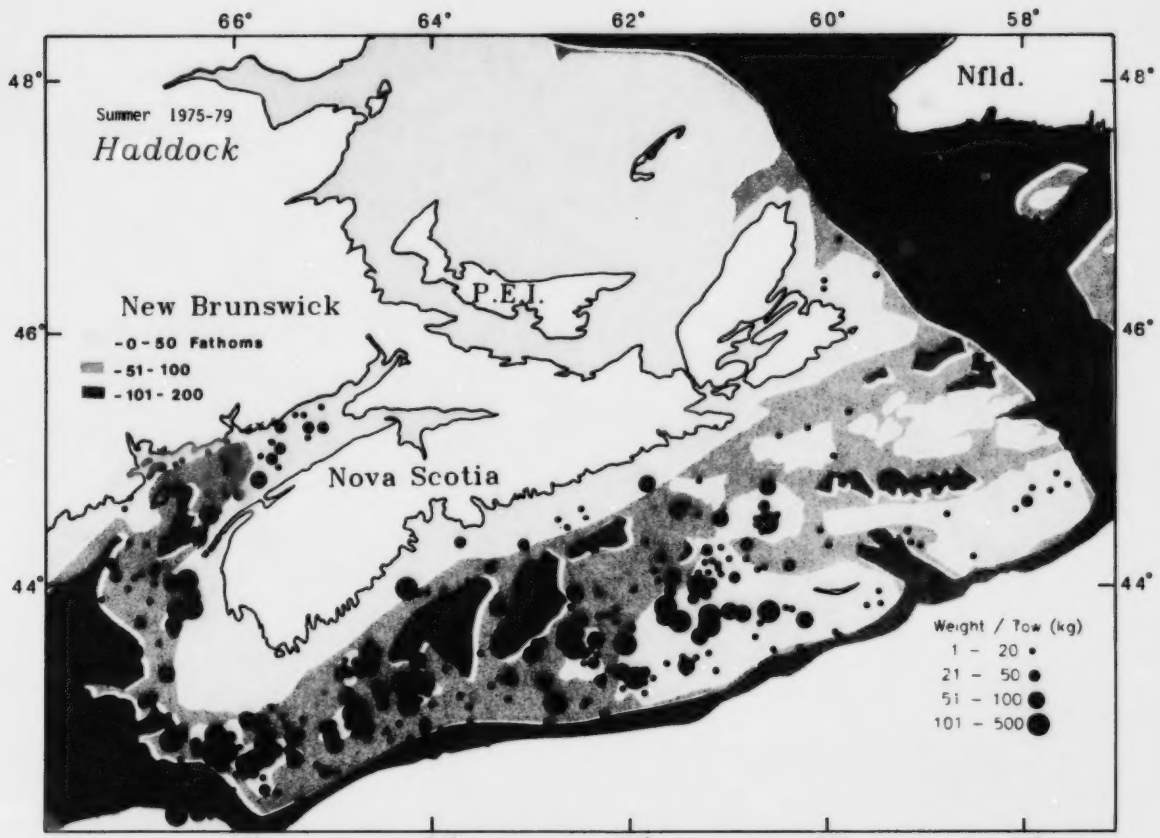
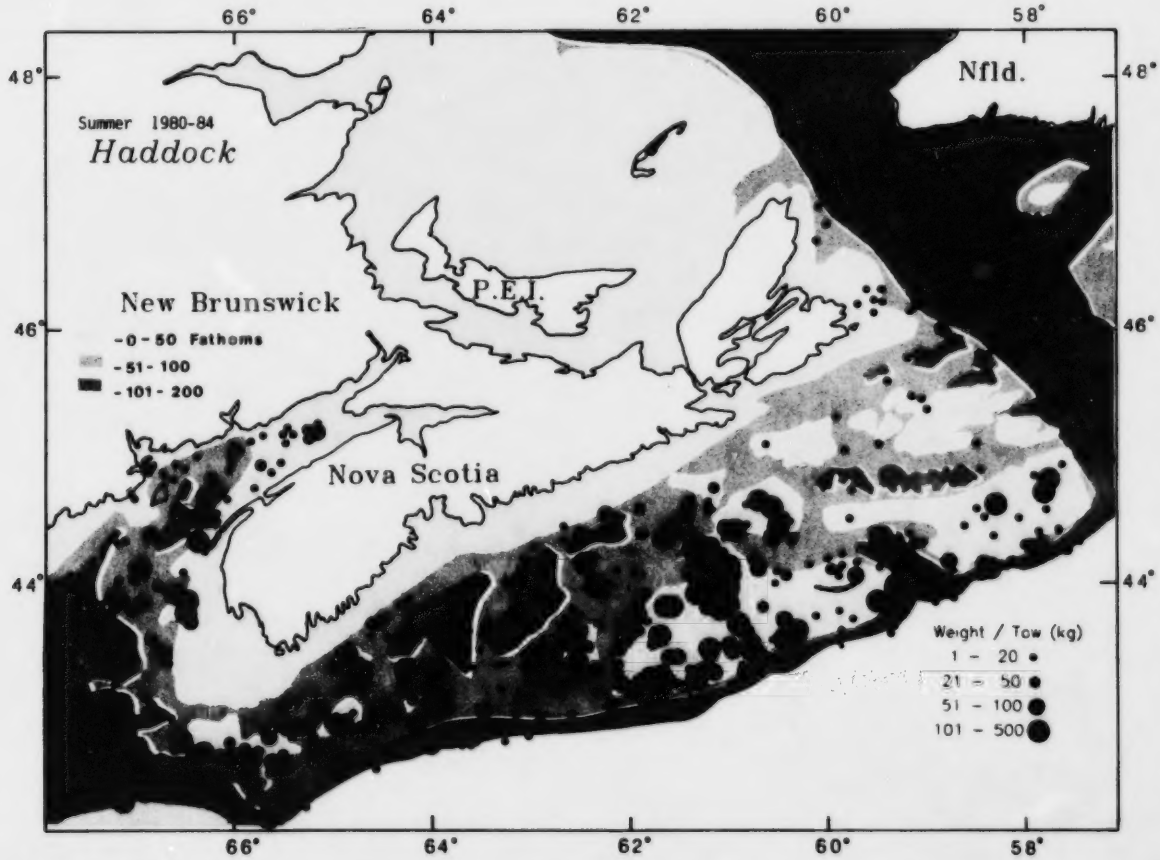
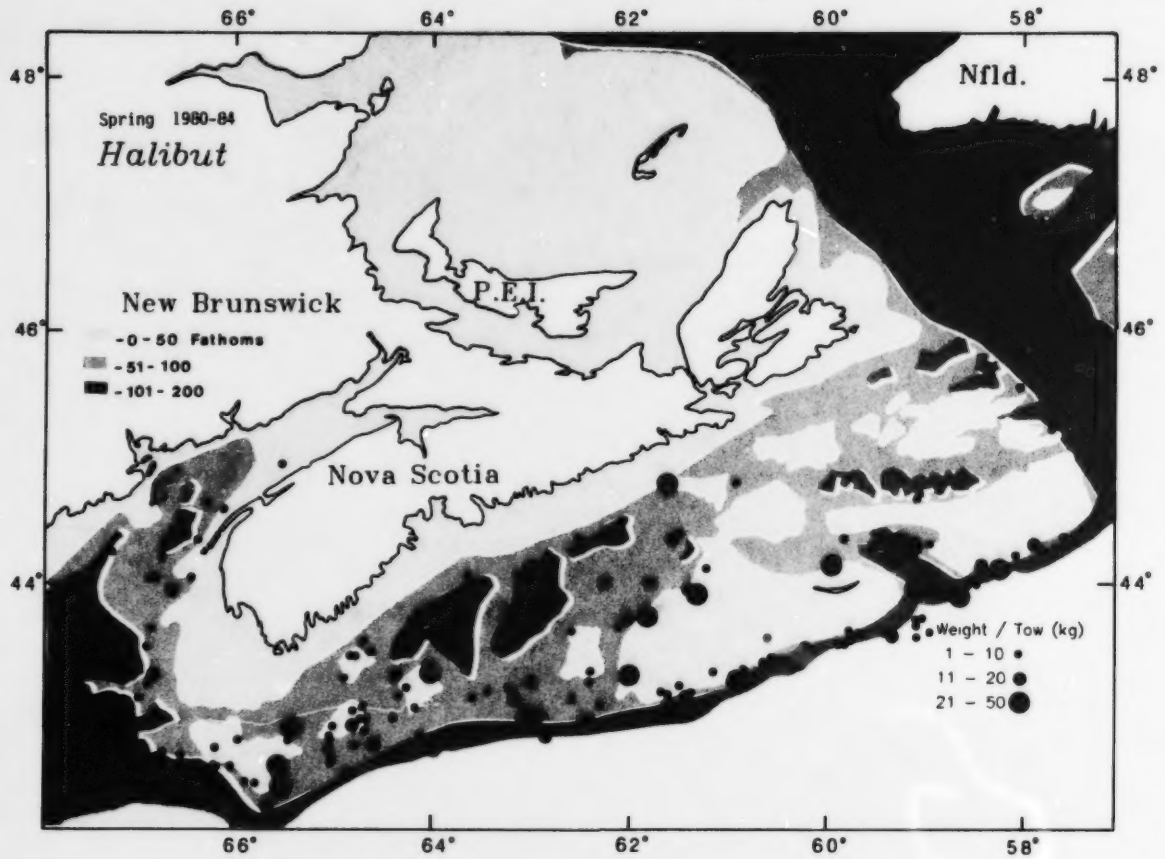


Fig. 10. Haddock (Melanogrammus aeglefinus)


66°
64°
62°
60°
58°
48°
46°
44°
Nfld.
Summer 1975-79
Haddock
New Brunswick
P.E.I.
Nova Scotia
-0-50 Fathoms
-51-100
-101-200
Weight / Tow (kg)
1 - 20
21 - 50
51 - 100
101 - 500


66°
64°
62°
60°
58°
48°
46°
44°
Nfld.
Summer 1980-84
Haddock
New Brunswick
P.E.I.
Nova Scotia
-0-50 Fathoms
-51-100
-101-200
Weight / Tow (kg)
1 - 20
21 - 50
51 - 100
101 - 500



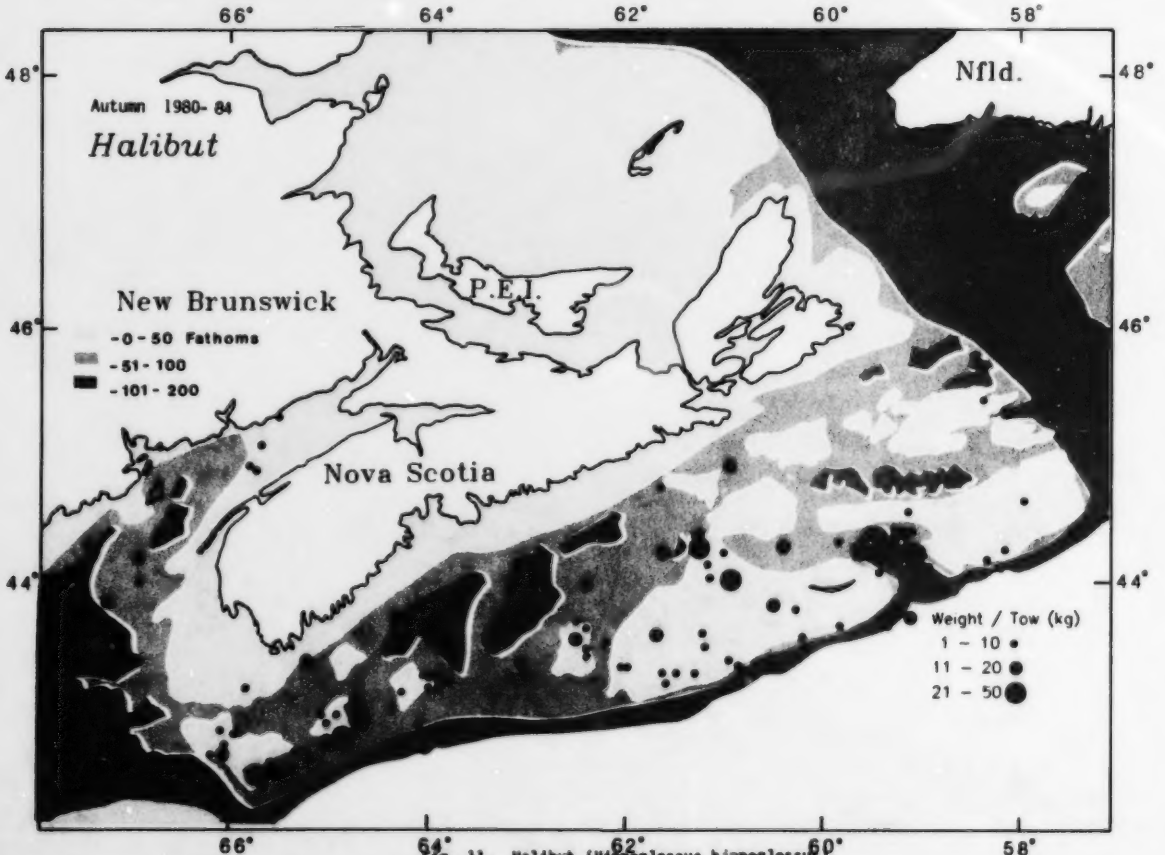
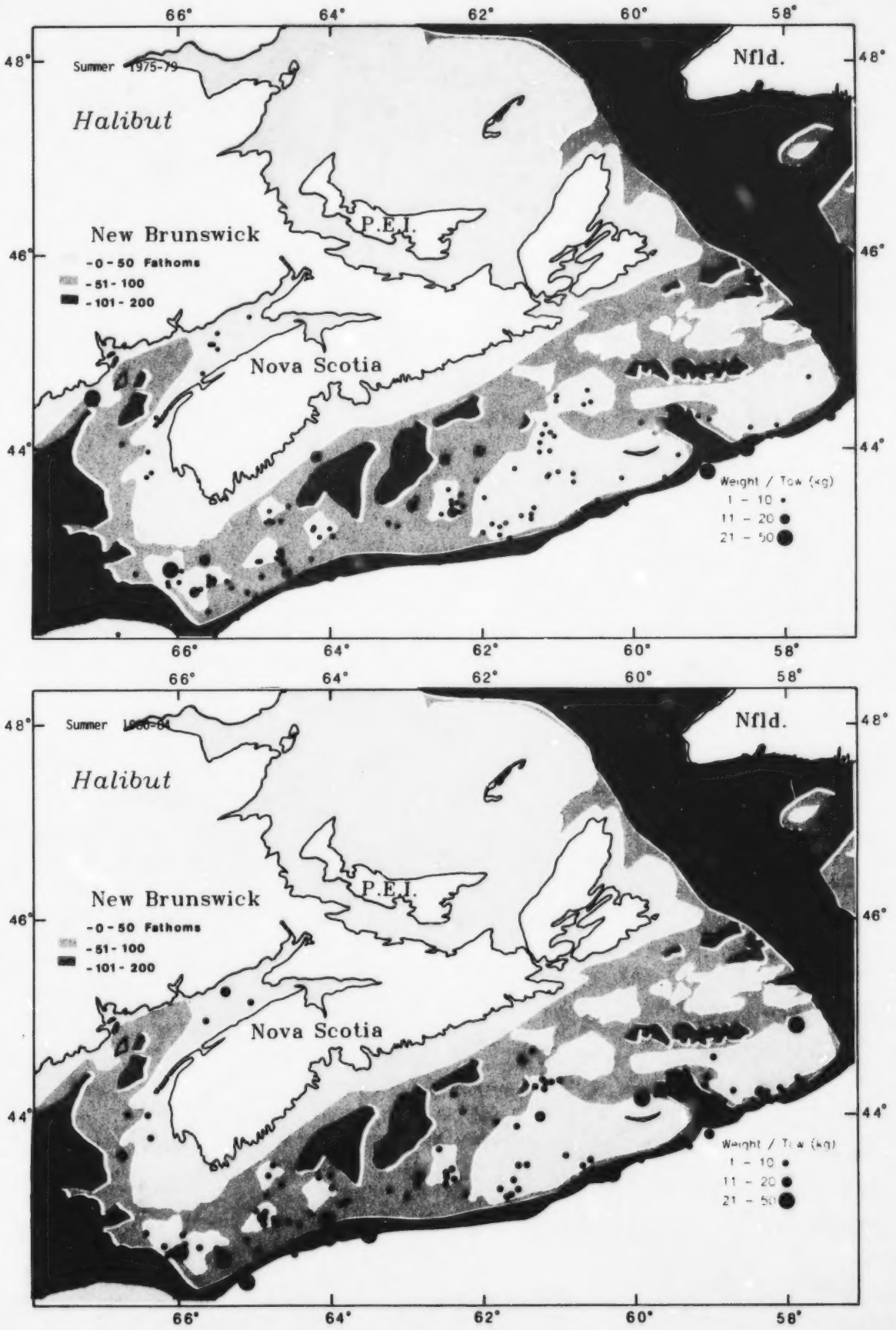


Fig. 11. Halibut (Hippoglossus hippoglossus)


66°
64°
62°
60°
58°
48°
46°
44°
Summer 1975-79
Halibut
Nfld.
P.E.I.
New Brunswick
-0-50 Fathoms
-51-100
-101-200
Nova Scotia
Weight / Tow (kg)
1 - 10
11 - 20
21 - 50
Summer 1980-84
Halibut
Nfld.
P.E.I.
New Brunswick
-0-50 Fathoms
-51-100
-101-200
Nova Scotia
Weight / Tow (kg)
1 - 10
11 - 20
21 - 50

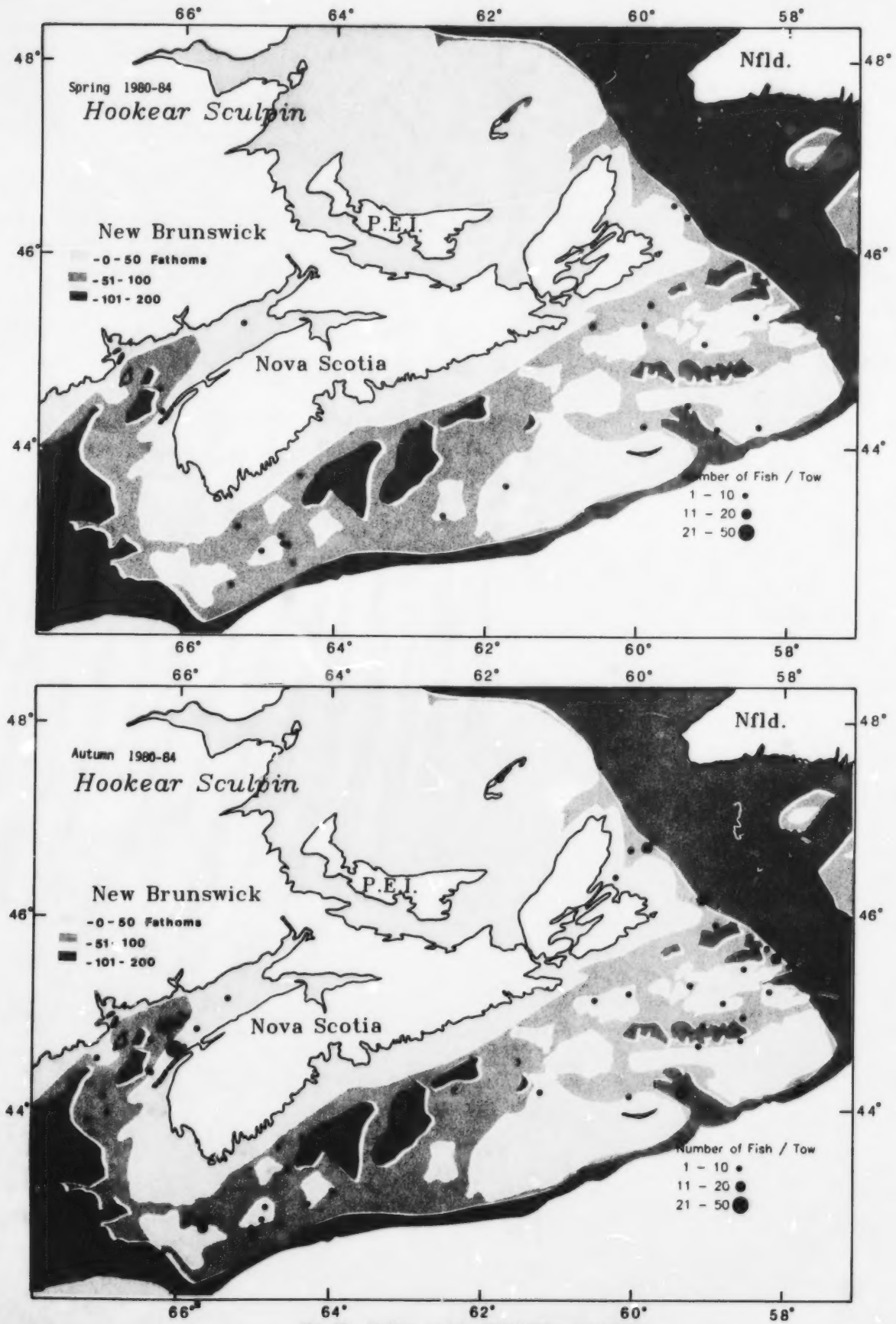
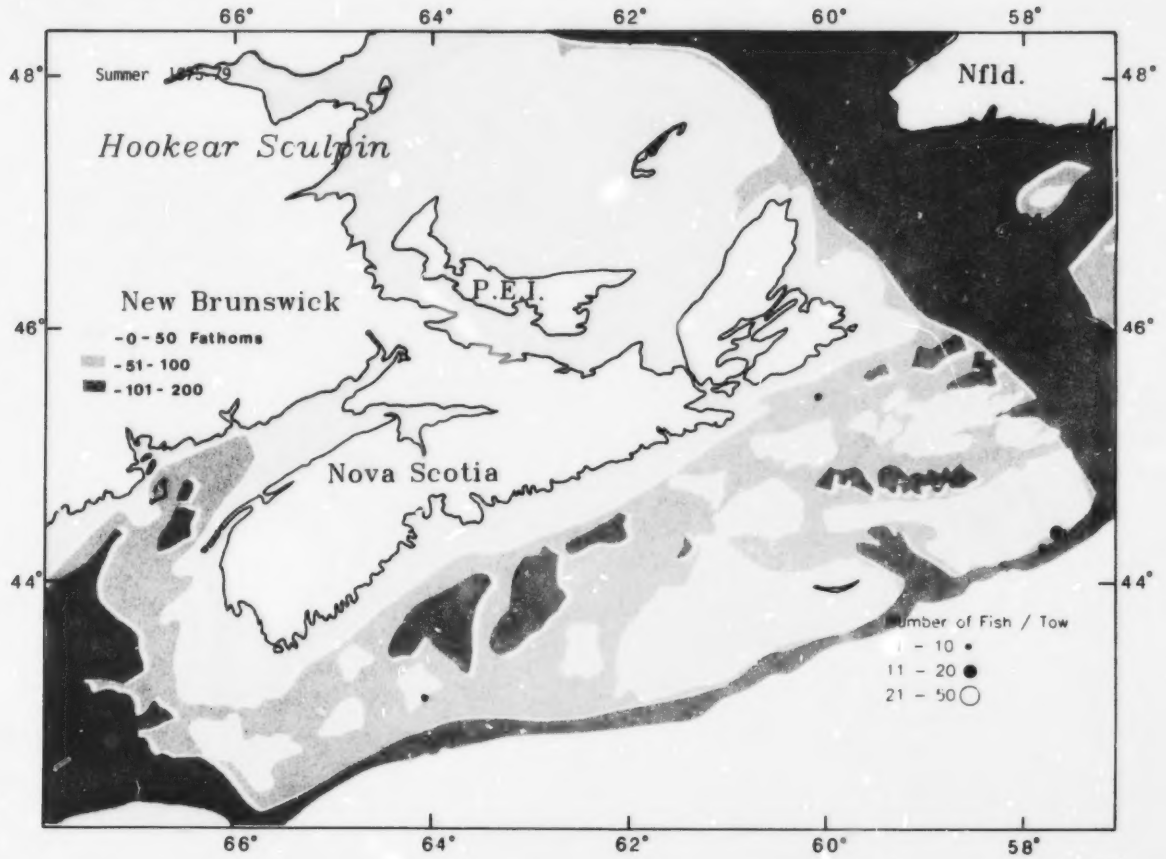
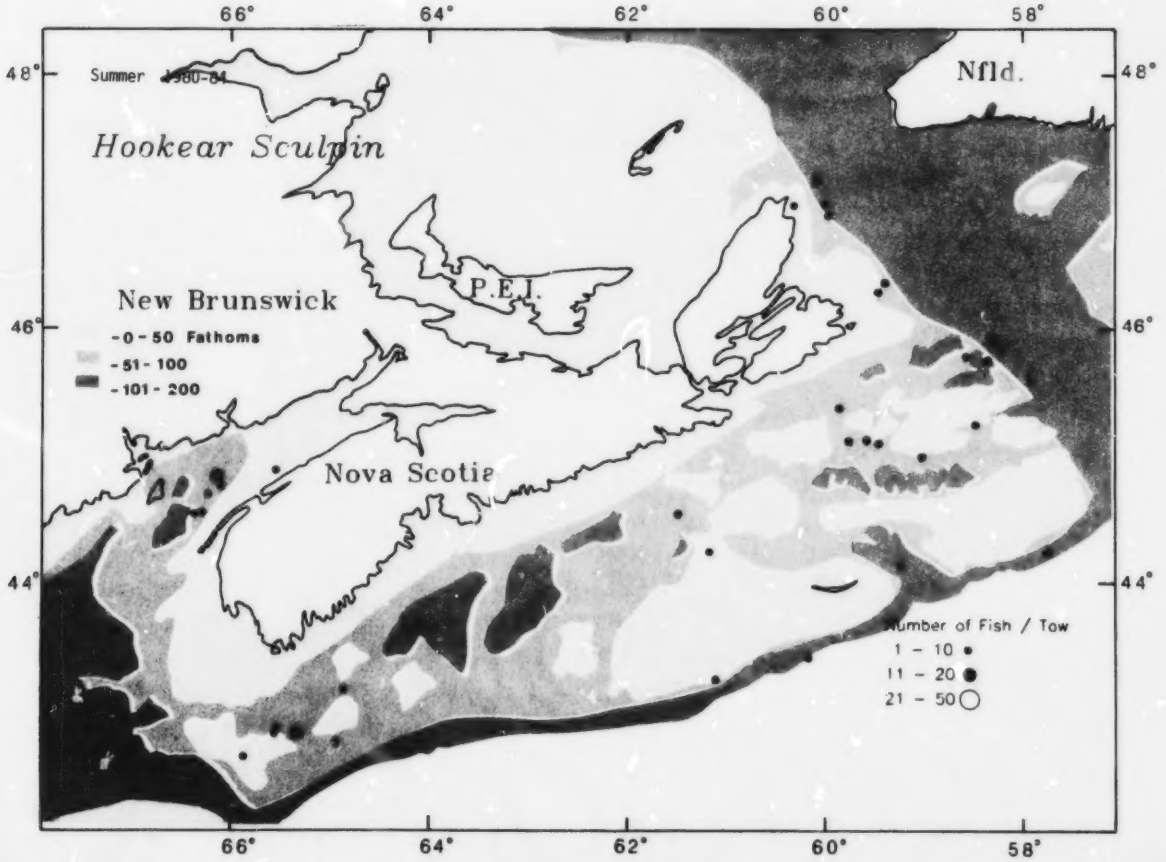


Fig. 12. Hookear sculpin (Artediellus americanus)


66°
64°
62°
60°
58°
48°
46°
44°
Summer 1975-79
Hookear Sculpin
Nfld.
P.E.I.
New Brunswick
-0-50 Fathoms
-51-100
-101-200
Nova Scotia
Number of Fish / Tow
1 - 10
11 - 20
21 - 50


66°
64°
62°
60°
58°
48°
46°
44°
Summer 1980-84
Hookear Sculpin
Nfld.
P.E.I.
New Brunswick
-0-50 Fathoms
-51-100
-101-200
Nova Scotia
Number of Fish / Tow
1 - 10
11 - 20
21 - 50

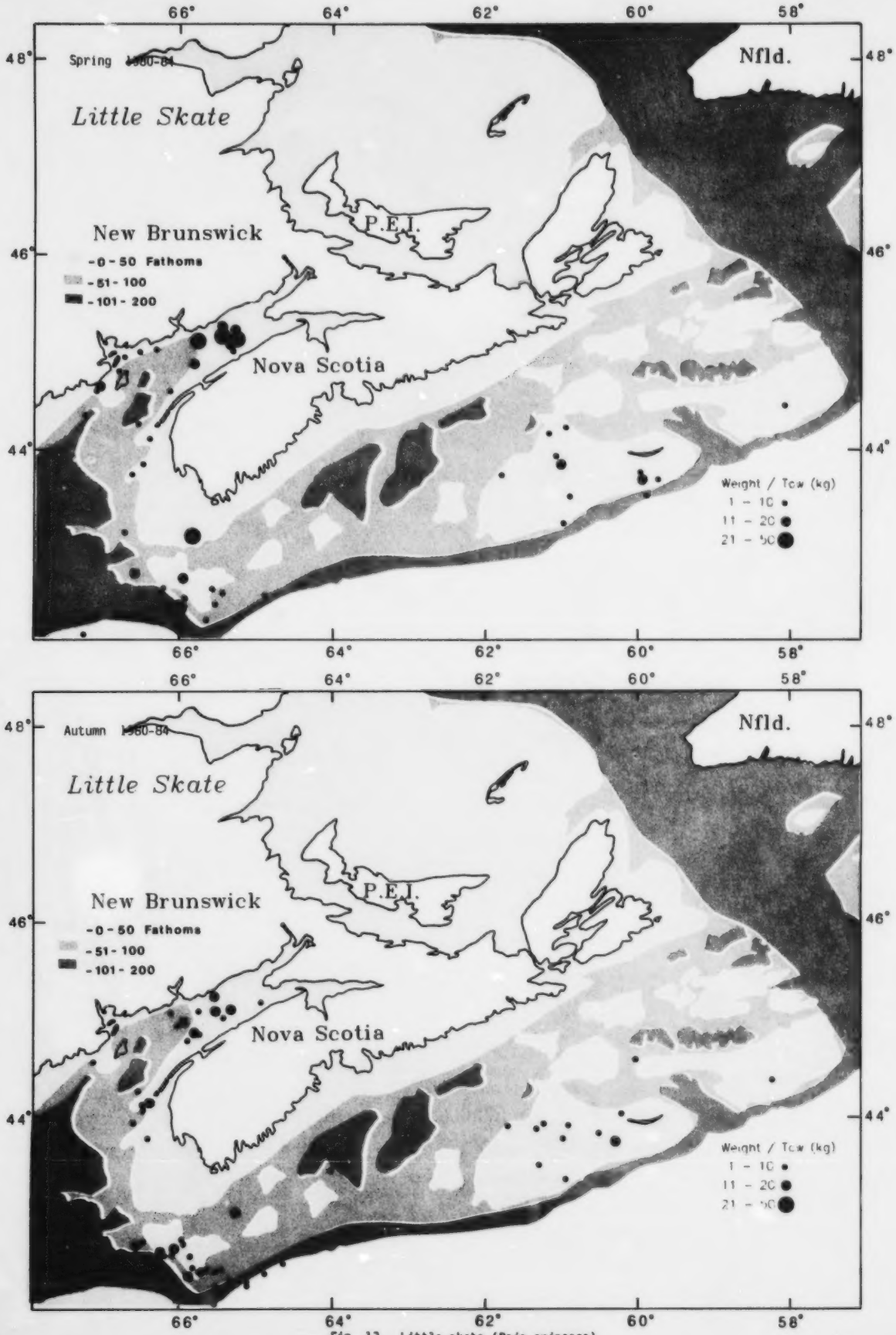
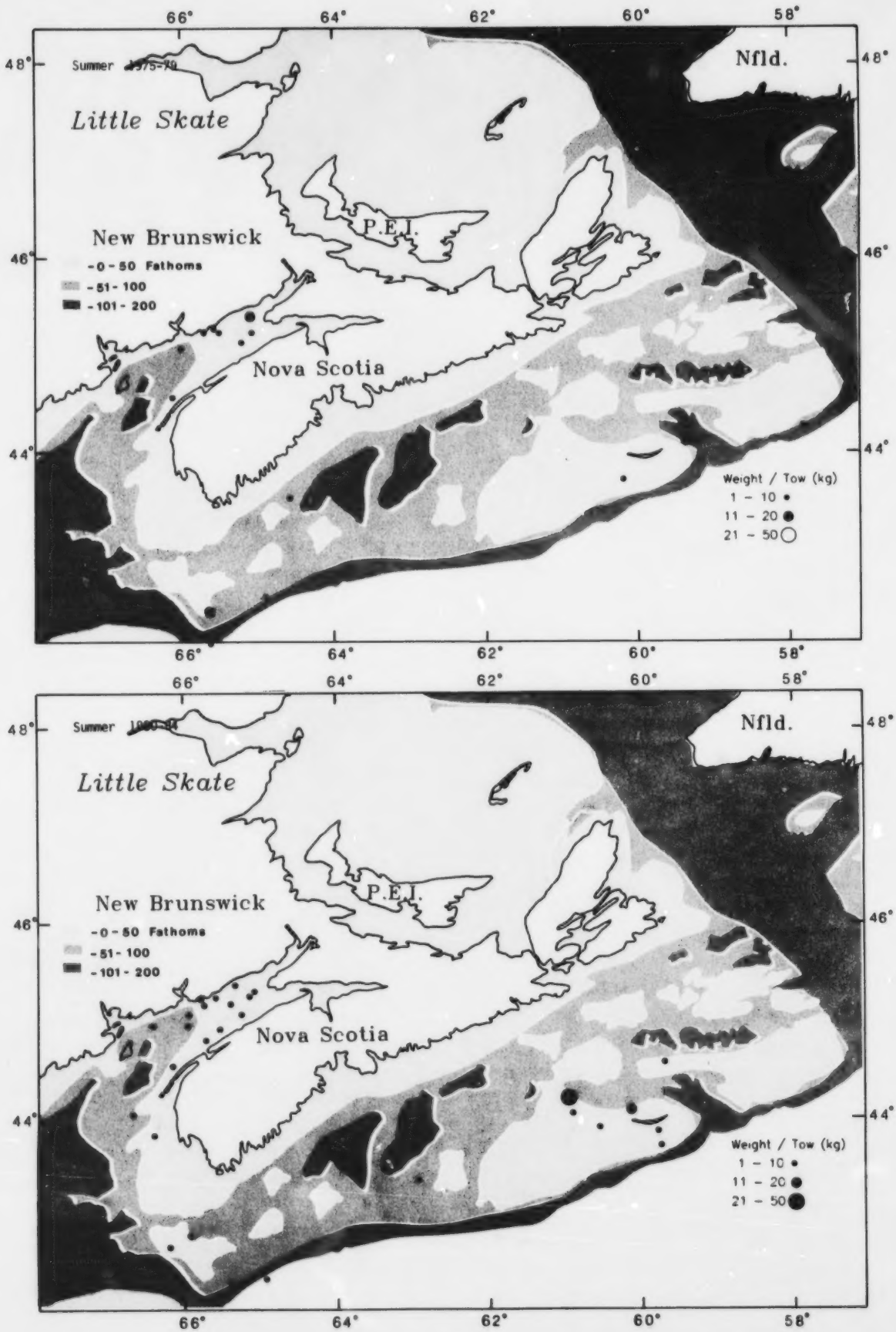


Fig. 13. Little skate (Raja erinacea)


66°
64°
62°
60°
58°
48°
46°
44°
Summer
Little Skate
Nfld.
P.E.I.
New Brunswick
-0-50 Fathoms
-51-100
-101-200
Nova Scotia
Weight / Tow (kg)
1 - 10
11 - 20
21 - 50

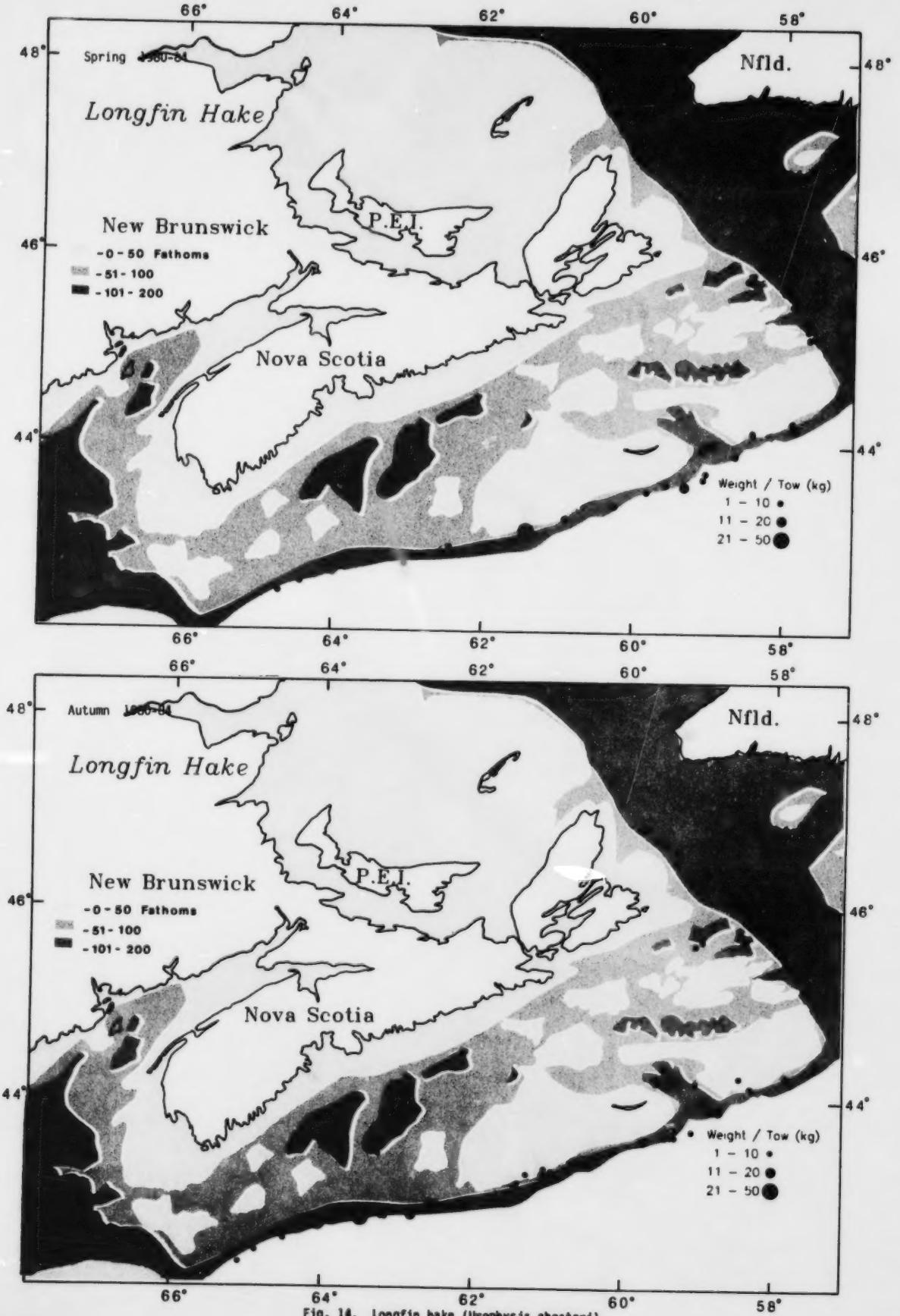
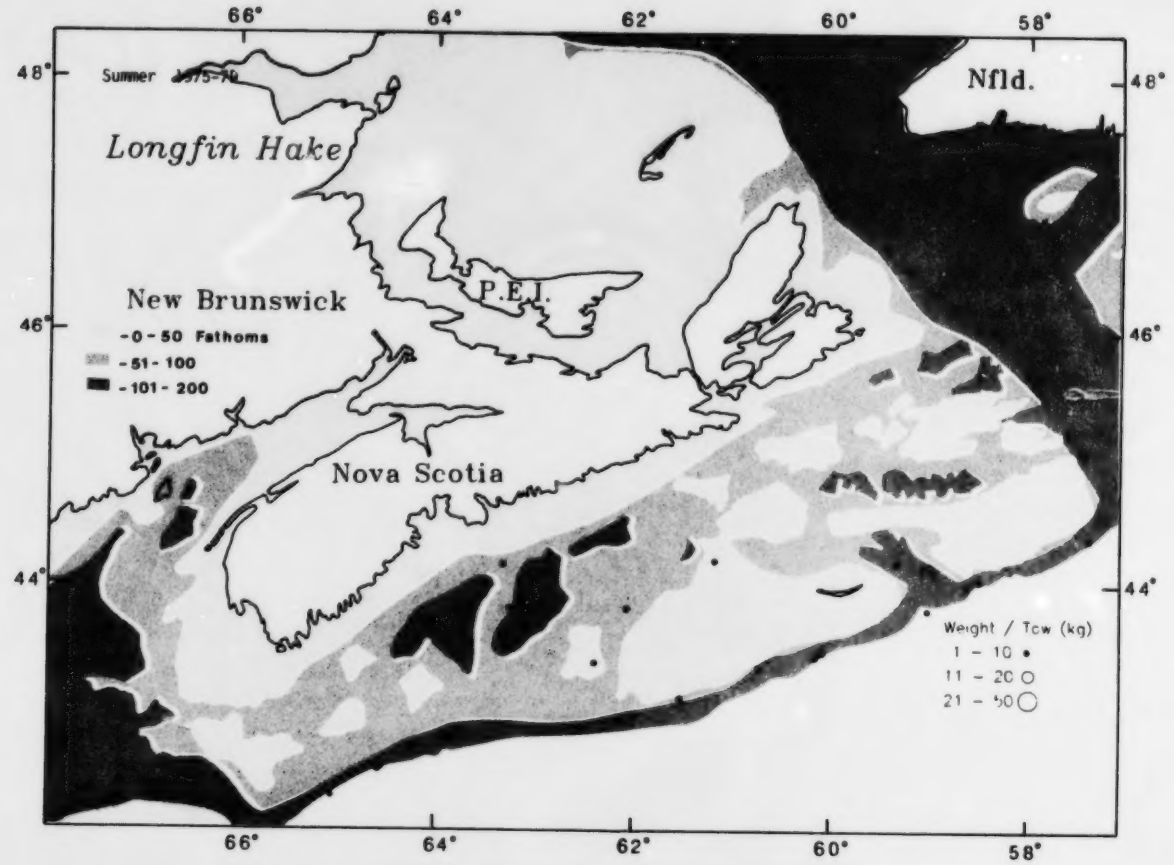
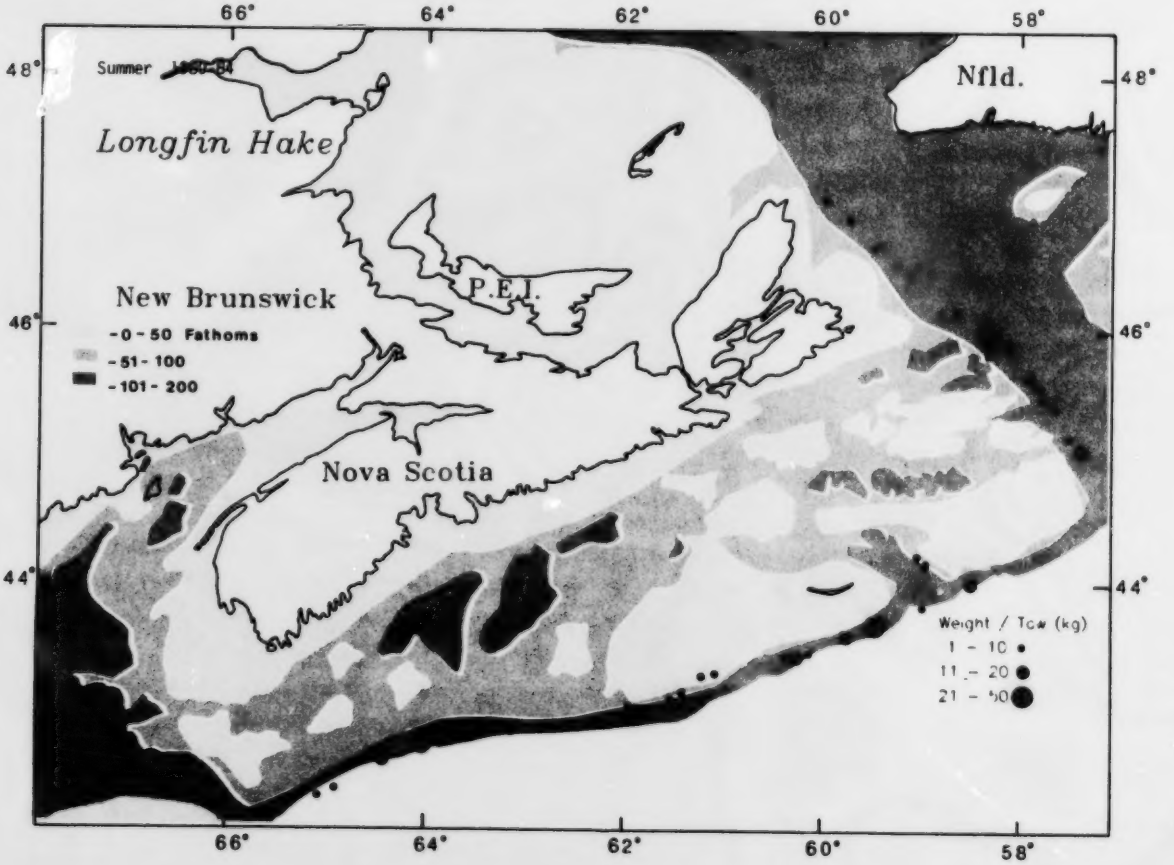


Fig. 14. Longfin hake (Urophycis chesteri)


66°
64°
62°
60°
58°
48°
46°
44°
Summer
Longfin Hake
Nfld.
New Brunswick
P.E.I.
Nova Scotia
-0-50 Fathoms
-51-100
-101-200
Weight / Tow (kg)
1 - 10
11 - 20
21 - 50


66°
64°
62°
60°
58°
48°
46°
44°
Summer
Longfin Hake
Nfld.
New Brunswick
P.E.I.
Nova Scotia
-0-50 Fathoms
-51-100
-101-200
Weight / Tow (kg)
1 - 10
11 - 20
21 - 50

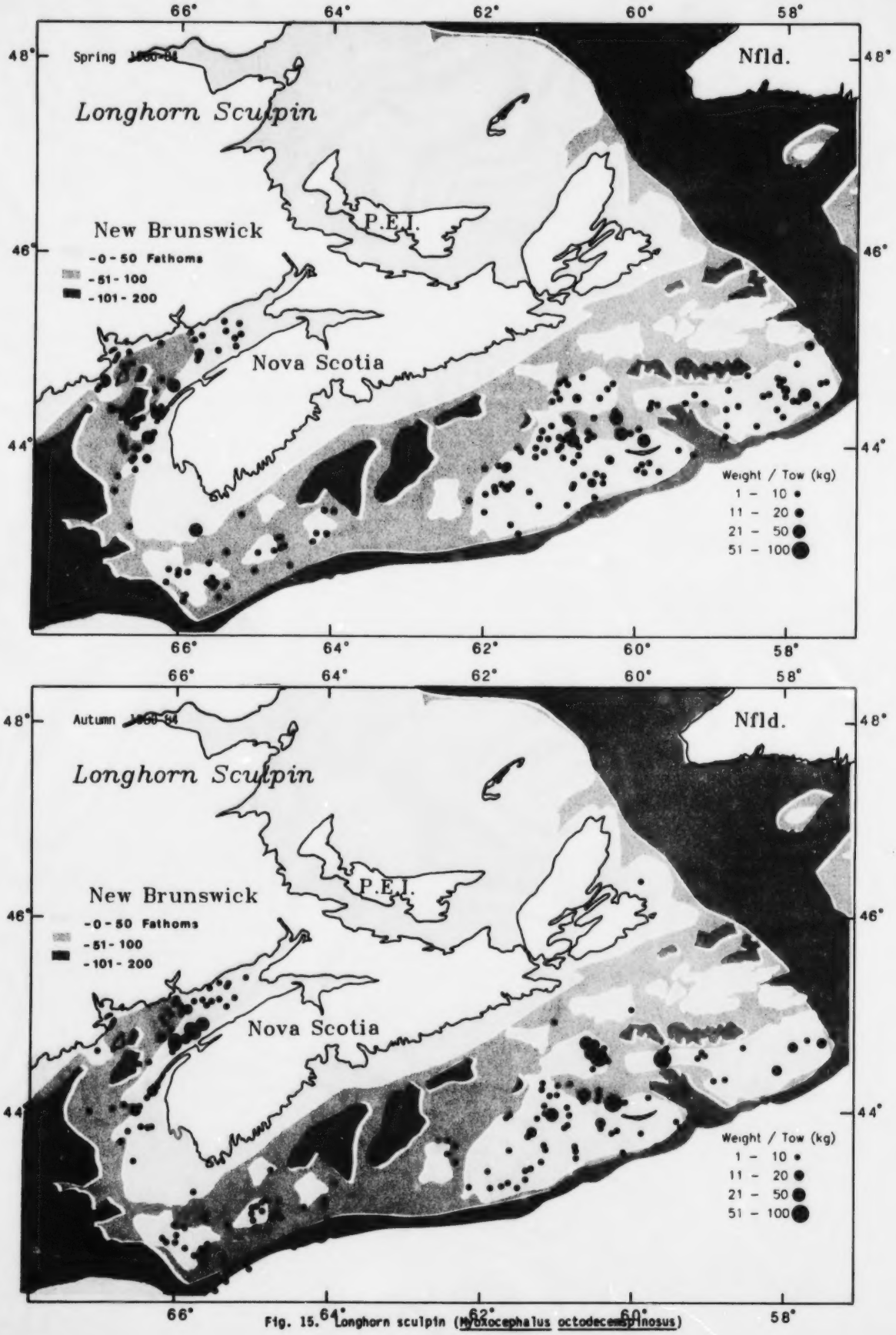
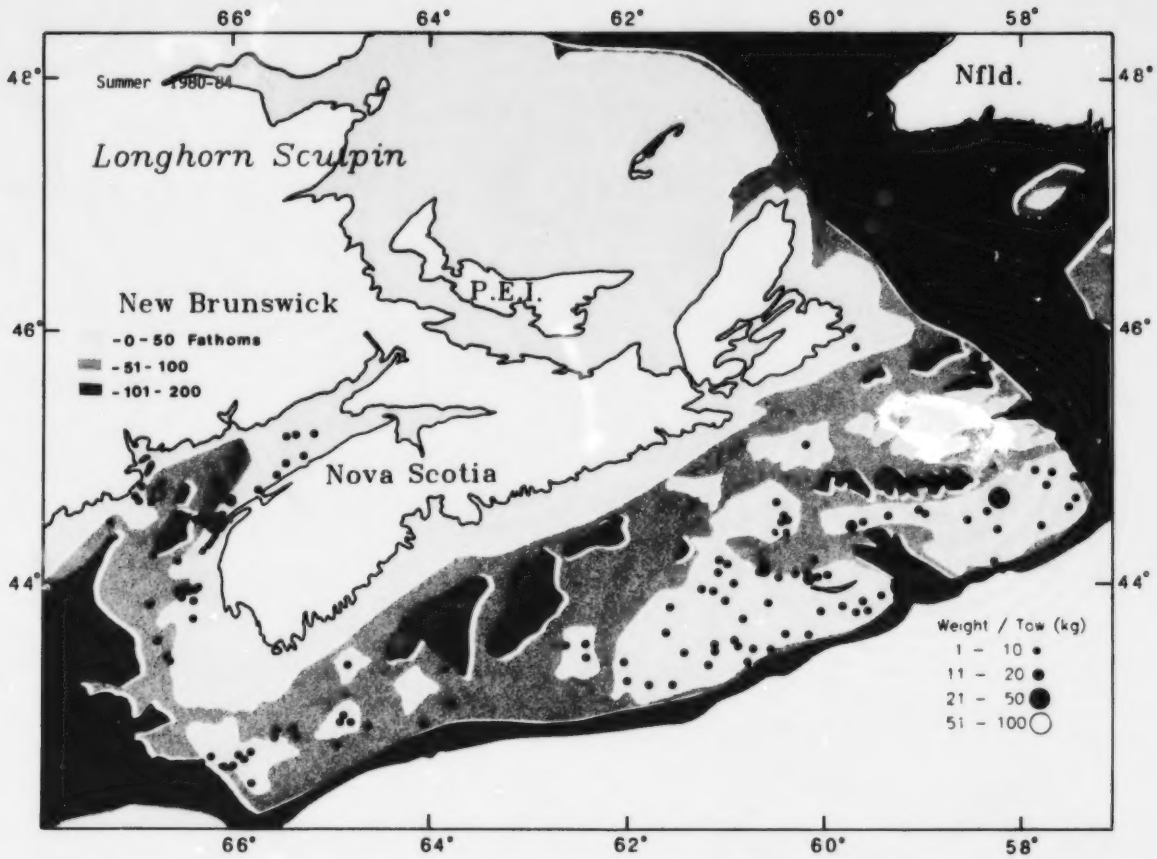
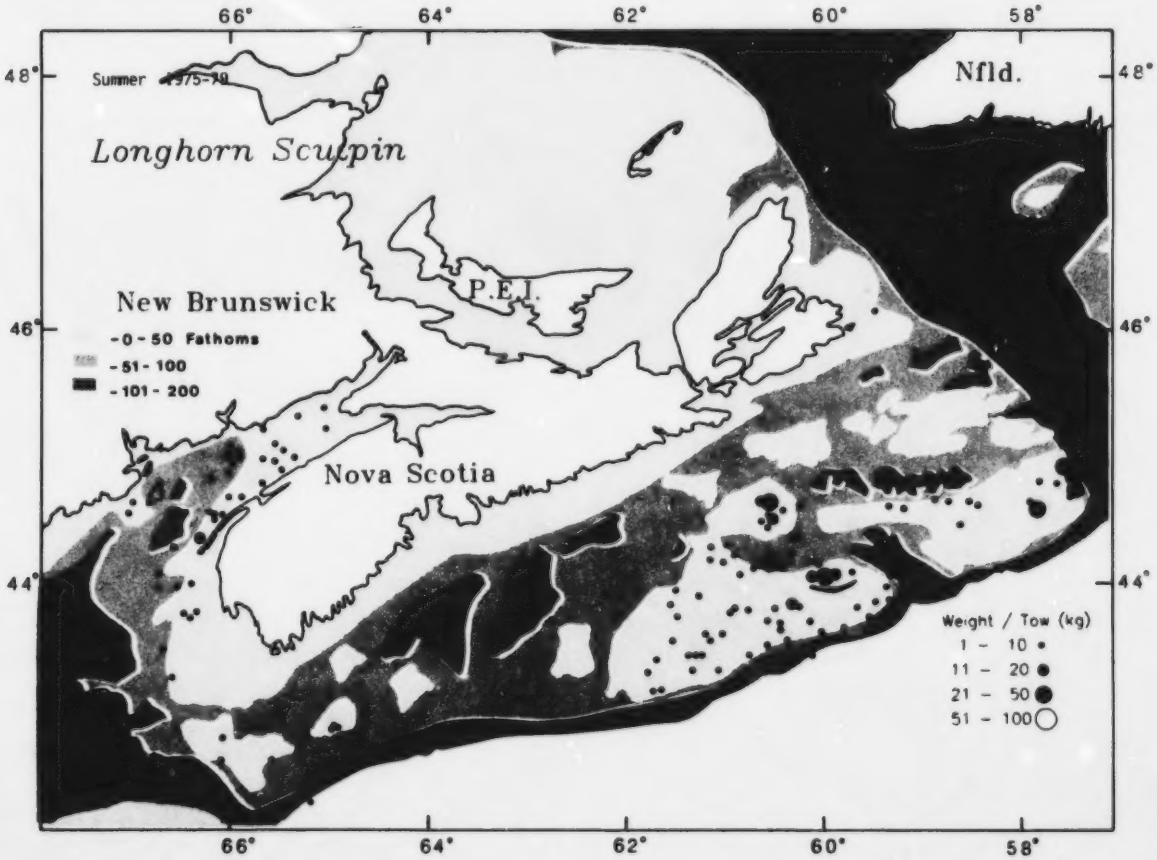


Fig. 15. Longhorn sculpin (Myoxocephalus octodecemspinosus)


66°
64°
62°
60°
58°
48°
46°
44°
Summer 1980-84
Longhorn Sculpin
Nfld.
P.E.I.
New Brunswick
-0-50 Fathoms
-51-100
-101-200
Nova Scotia
Weight / Tow (kg)
1 - 10
11 - 20
21 - 50
51 - 100


66°
64°
62°
60°
58°
48°
46°
44°
Summer 1975-79
Longhorn Sculpin
Nfld.
P.E.I.
New Brunswick
-0-50 Fathoms
-51-100
-101-200
Nova Scotia
Weight / Tow (kg)
1 - 10
11 - 20
21 - 50
51 - 100

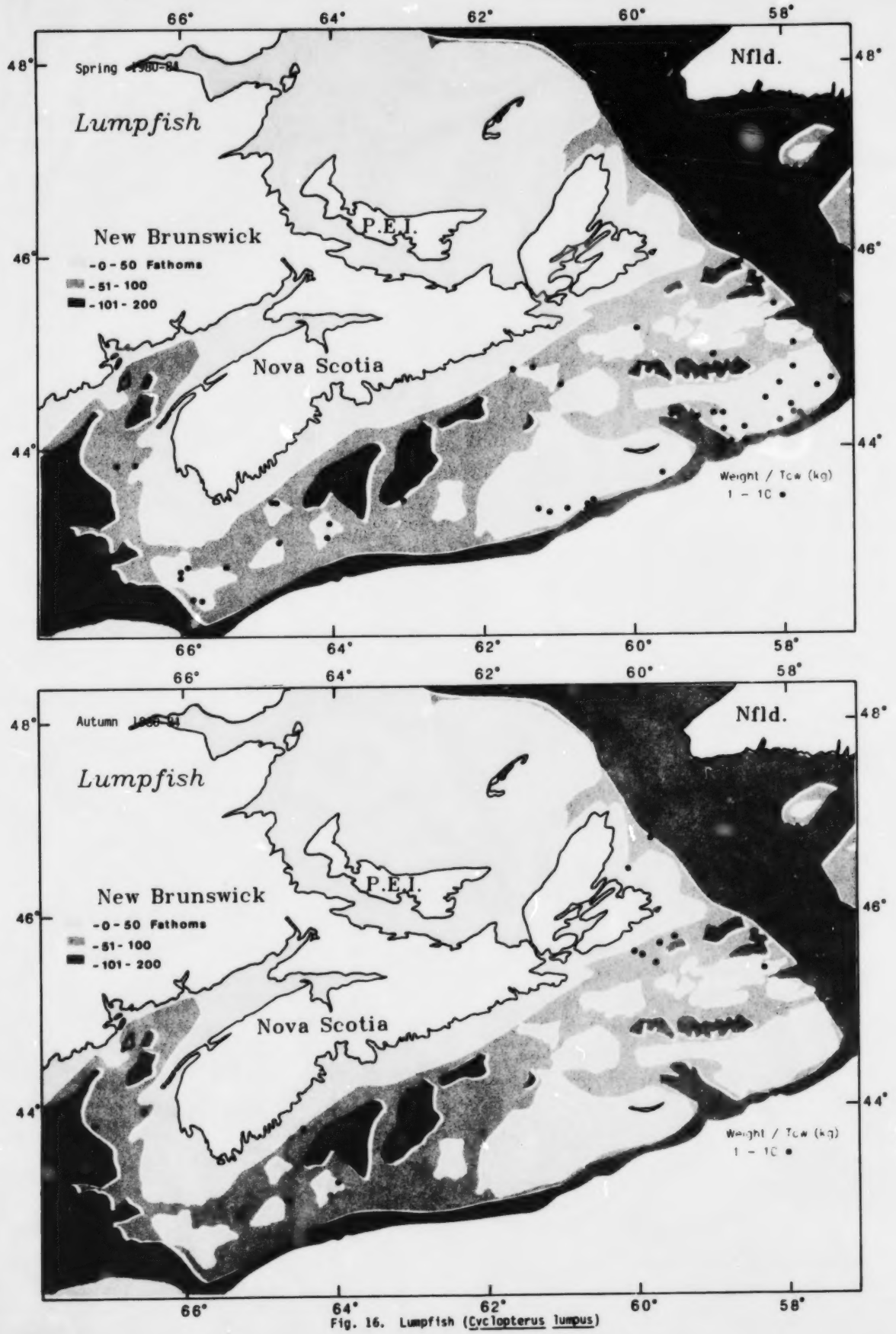
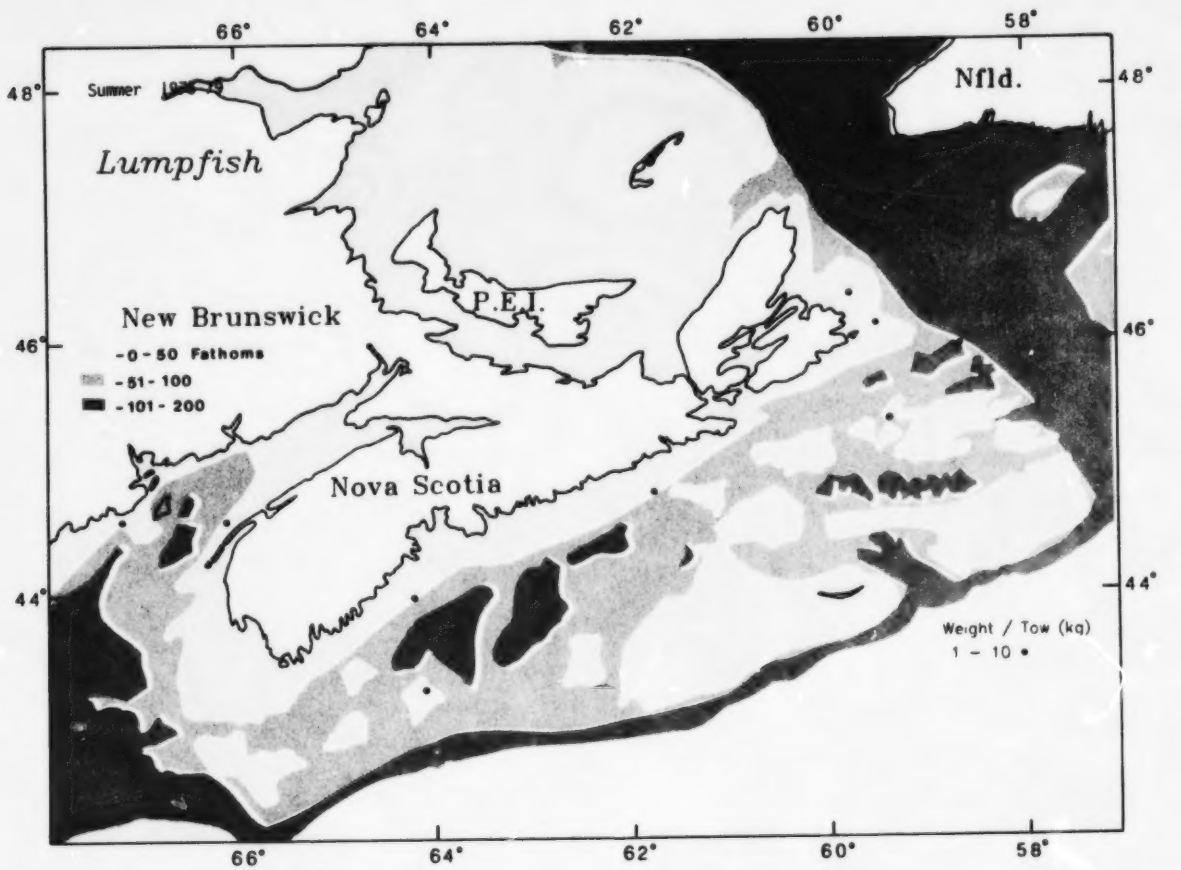
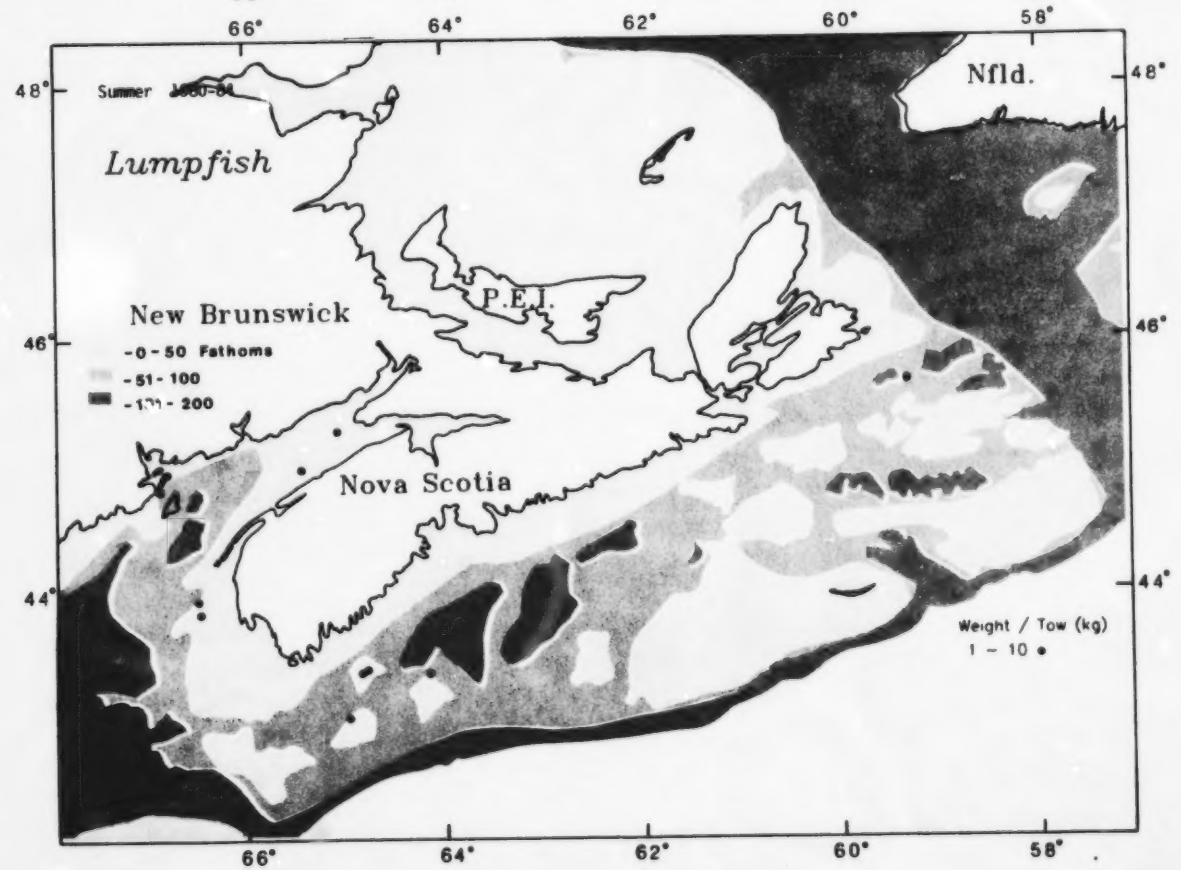


Fig. 16. Lumpfish (Cyclopterus lumpus)


66°
64°
62°
60°
58°
48°
46°
44°
Summer
Lumpfish
Nfld.
P.E.I.
New Brunswick
-0-50 Fathoms
-51-100
-101-200
Nova Scotia
Weight / Tow (kg)
1 - 10 •


66°
64°
62°
60°
58°
48°
46°
44°
Summer
Lumpfish
Nfld.
P.E.I.
New Brunswick
-0-50 Fathoms
-51-100
-200
Nova Scotia
Weight / Tow (kg)
1 - 10 •

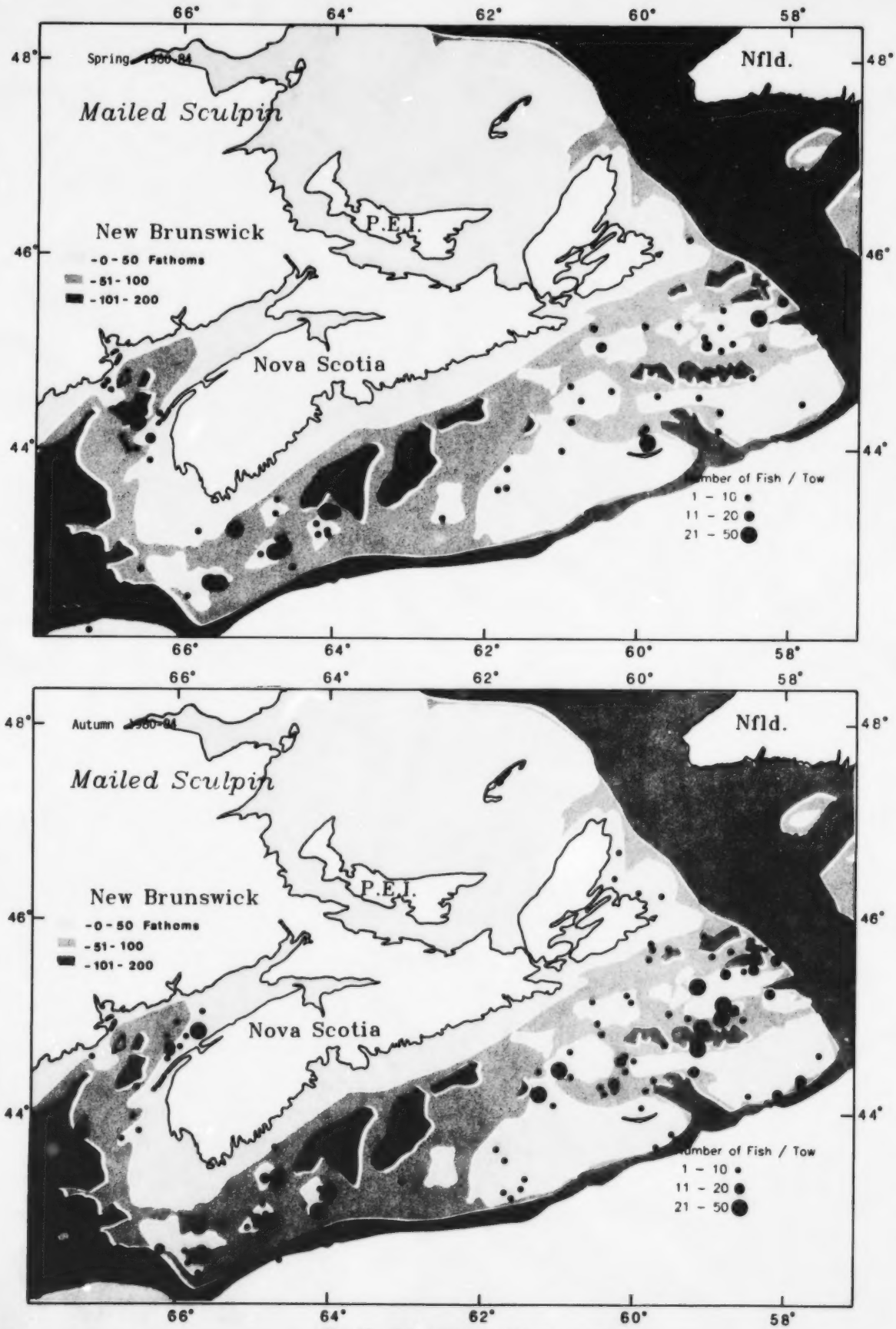
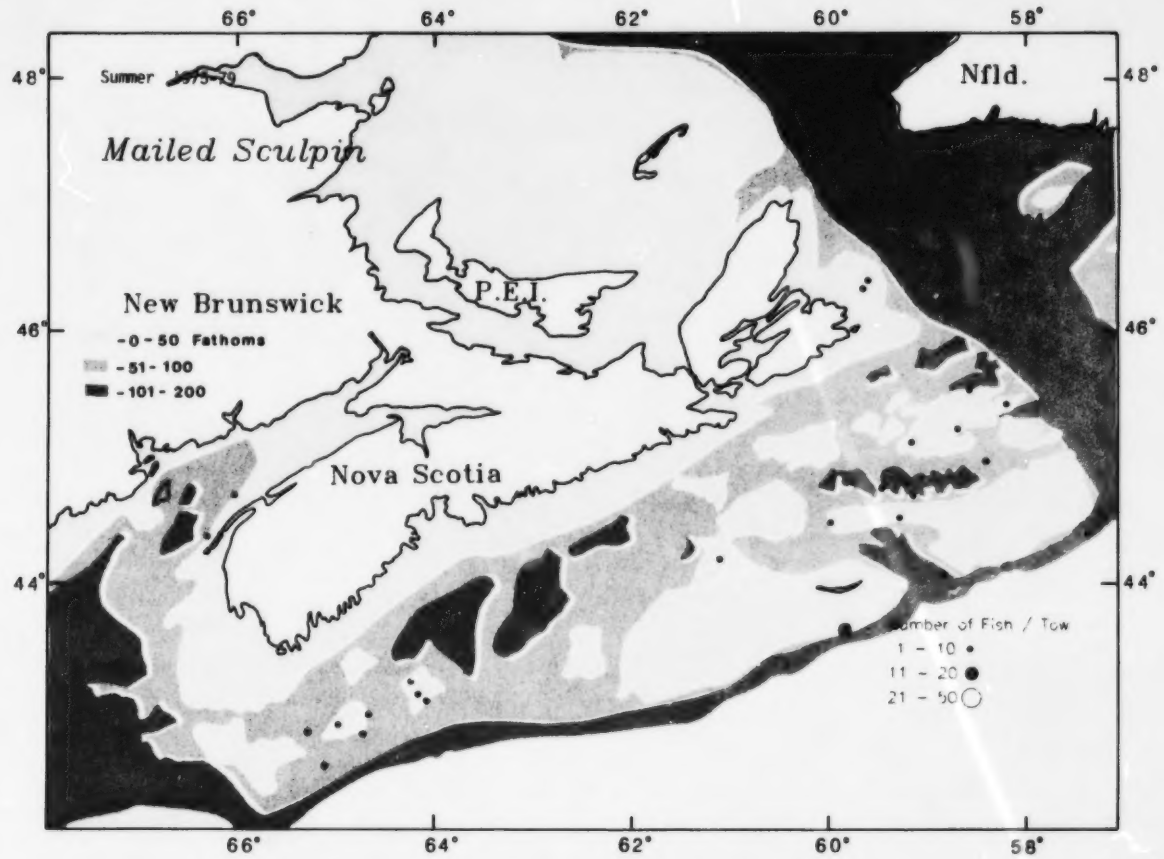
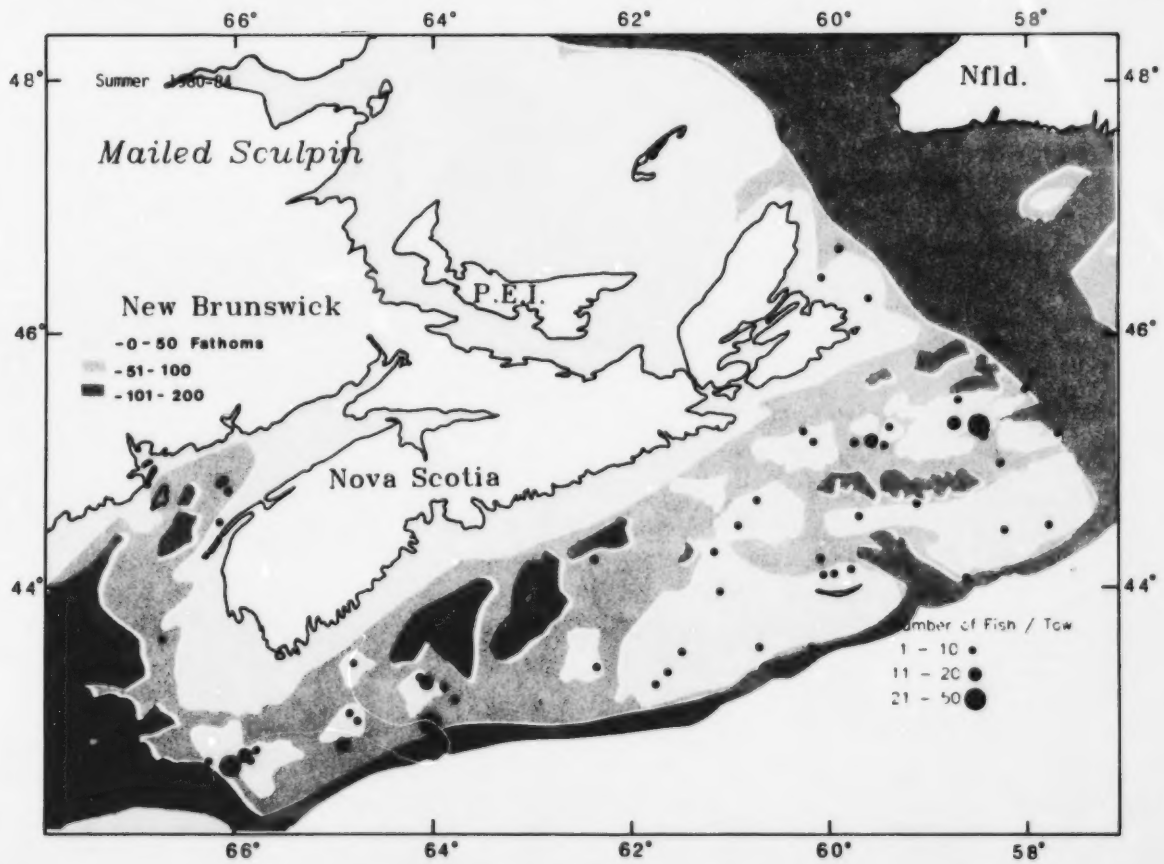


Fig. 17. Mailed sculpin (Triglops murrayi)


66°
64°
62°
60°
58°
48°
46°
44°
Summer 1975-79
Mailed Sculpin
Nfld.
New Brunswick
P.E.I.
Nova Scotia
-0-50 Fathoms
-51-100
-101-200
Number of Fish / Tow
1 - 10
11 - 20
21 - 50


66°
64°
62°
60°
58°
48°
46°
44°
Summer 1980-84
Mailed Sculpin
Nfld.
New Brunswick
P.E.I.
Nova Scotia
-0-50 Fathoms
-51-100
-101-200
Number of Fish / Tow
1 - 10
11 - 20
21 - 50

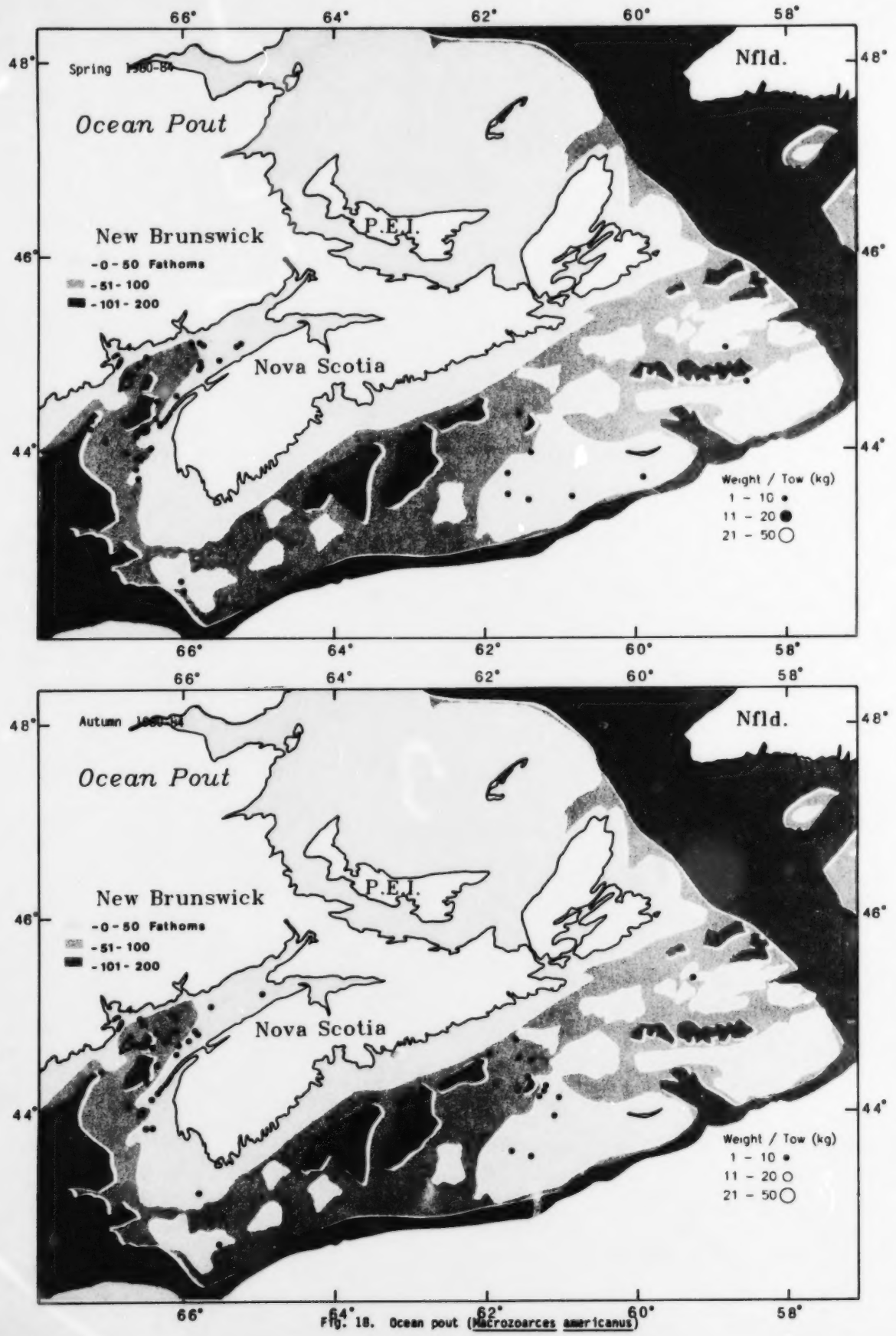
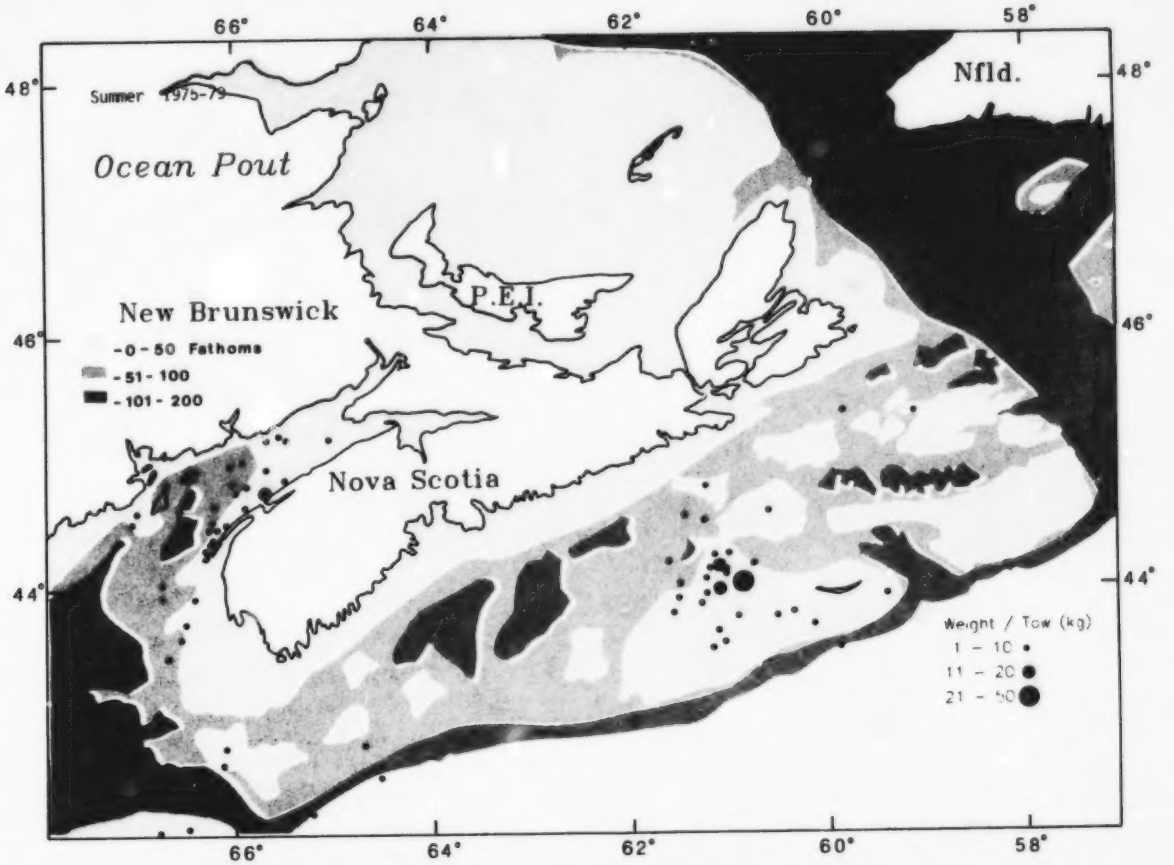
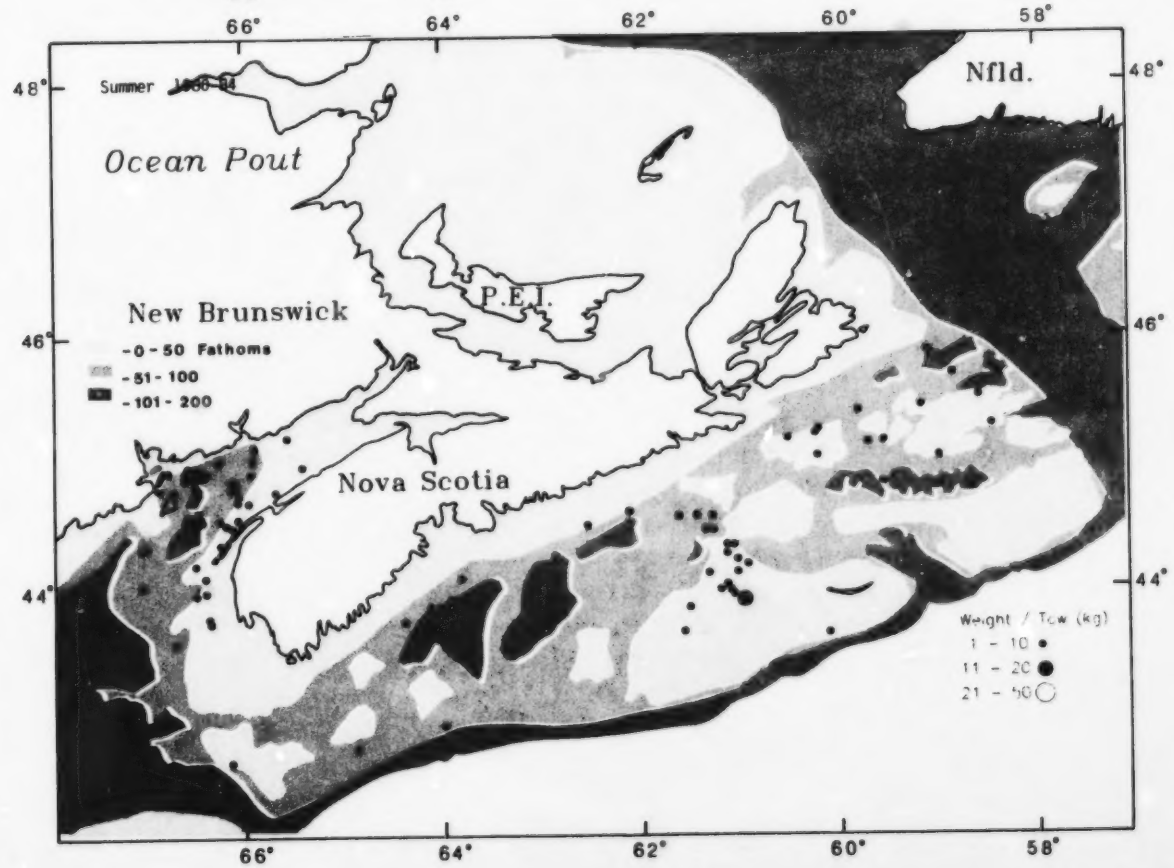


Fig. 18. Ocean pout (Macrozoarces americanus)


66°
64°
62°
60°
58°
48°
46°
44°
Summer 1975-79
Ocean Pout
Nfld.
P.E.I.
New Brunswick
-0-50 Fathoms
-51-100
-101-200
Nova Scotia
Weight / Tow (kg)
1 - 10
11 - 20
21 - 50


66°
64°
62°
60°
58°
48°
46°
44°
Summer 1980-84
Ocean Pout
Nfld.
P.E.I.
New Brunswick
-0-50 Fathoms
-51-100
-101-200
Nova Scotia
Weight / Tow (kg)
1 - 10
11 - 20
21 - 50

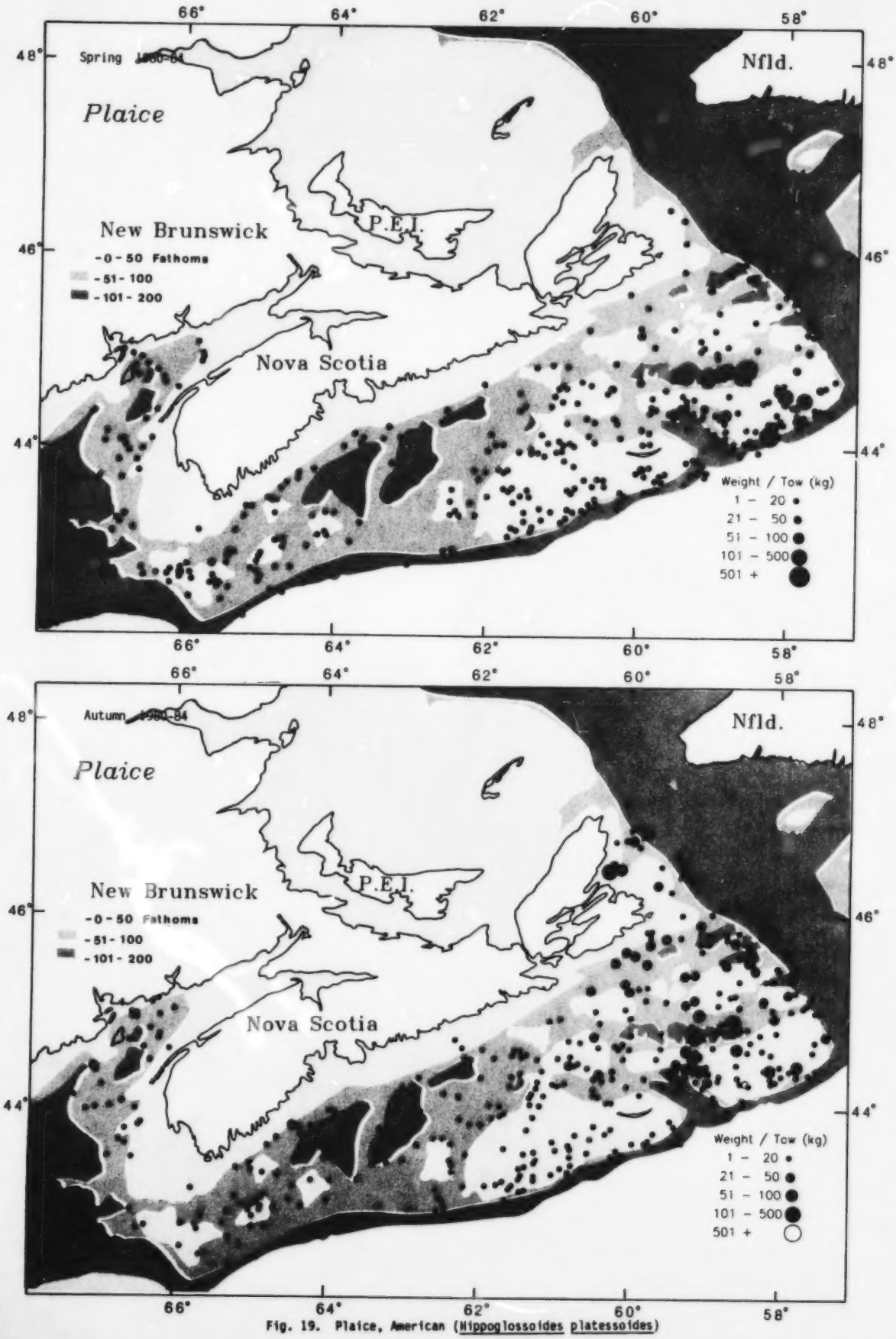
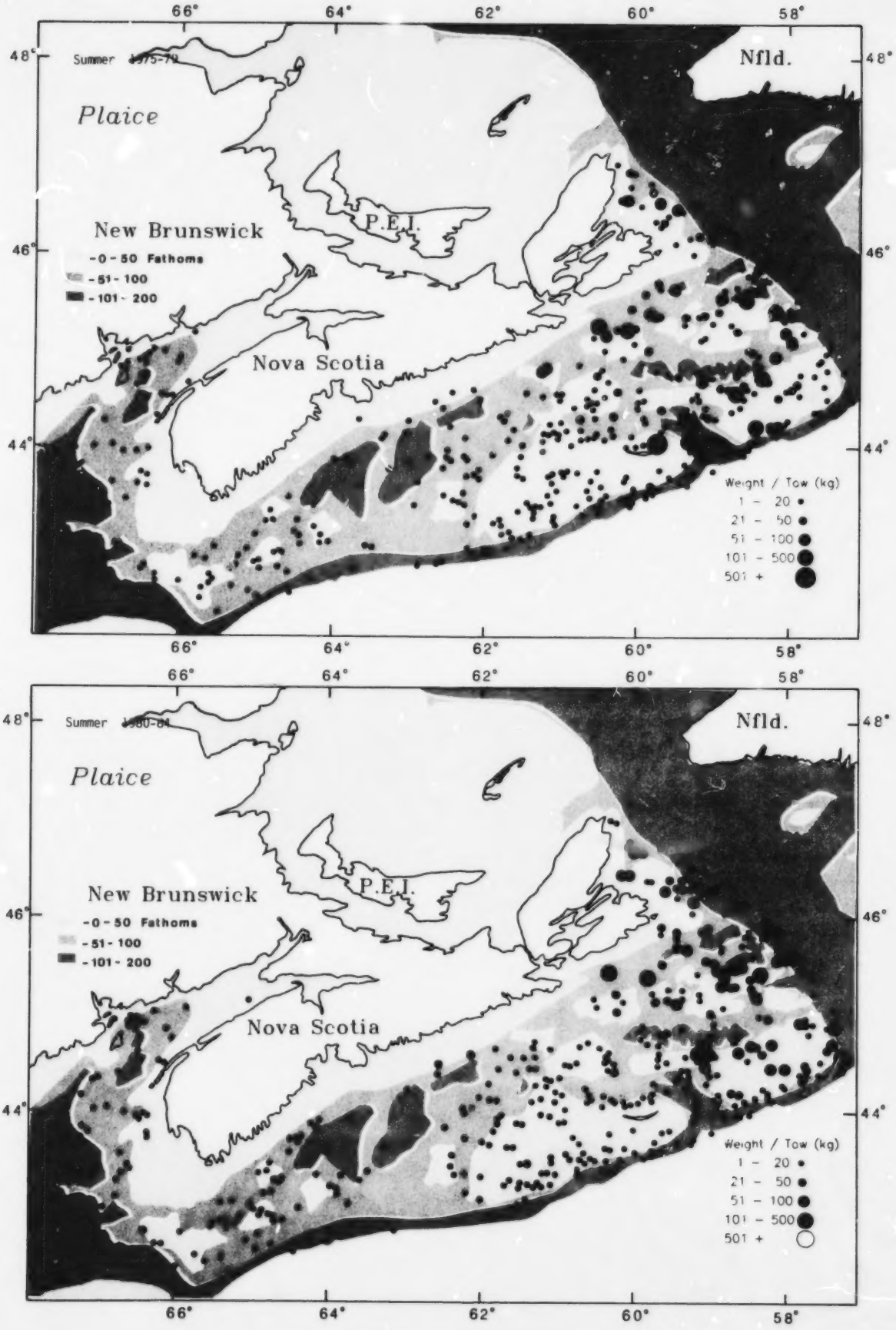


Fig. 19. Plaice, American (Hippoglossoides platessoides)


66°
64°
62°
60°
58°
48°
46°
44°
Summer 1975-79
Plaice
Nfld.
New Brunswick
P.E.I.
Nova Scotia
-0-50 Fathoms
-51-100
-101-200
Weight / Tow (kg)
1 - 20
21 - 50
51 - 100
101 - 500
501 +
Summer 1980-84
Plaice
Nfld.
New Brunswick
P.E.I.
Nova Scotia
-0-50 Fathoms
-51-100
-101-200
Weight / Tow (kg)
1 - 20
21 - 50
51 - 100
101 - 500
501 +

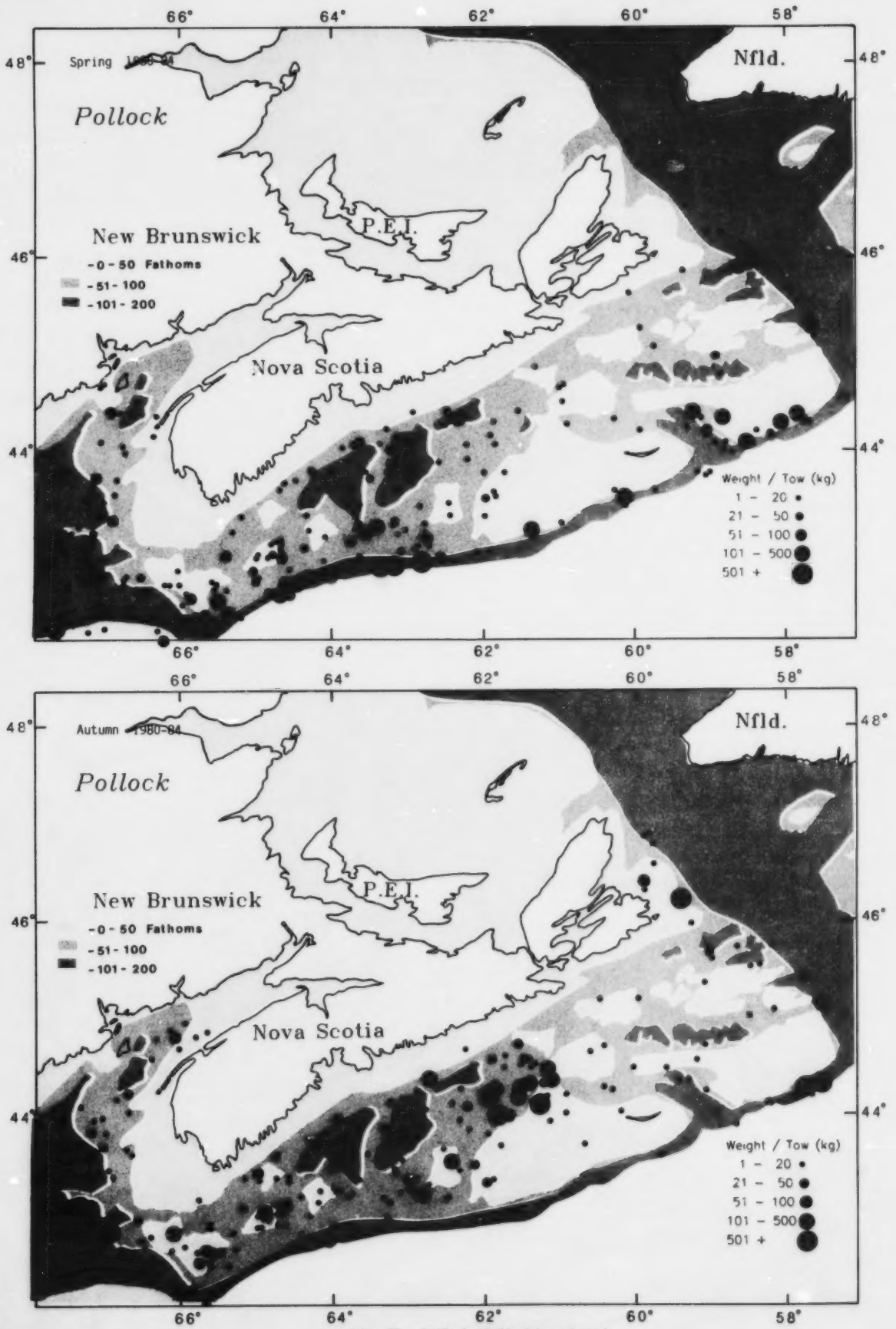
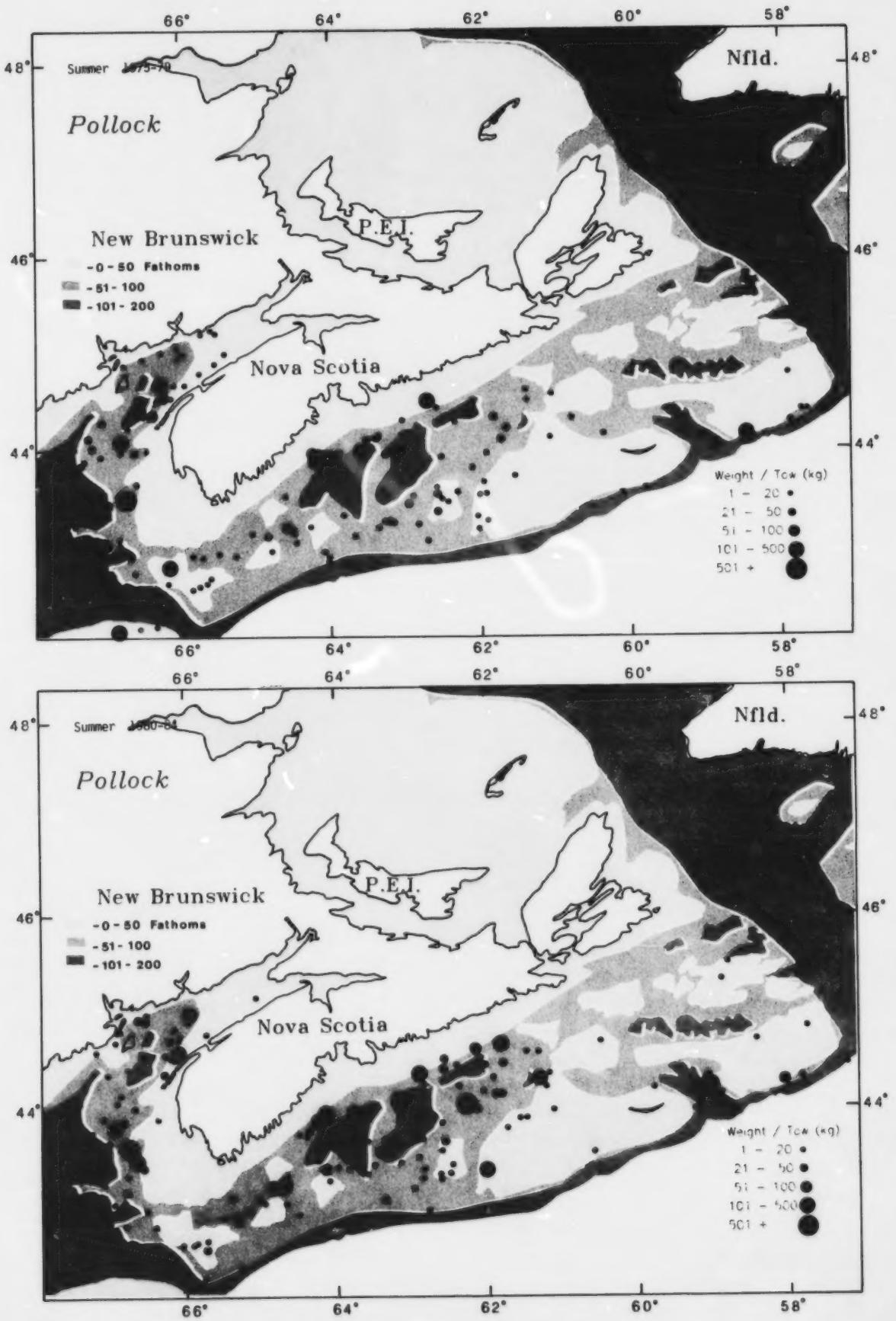


Fig. 20. Pollock (Pollachius virens)


66°
64°
62°
60°
58°
48°
46°
44°
Summer
Pollock
Nfld.
P.E.I.
New Brunswick
-0-50 Fathoms
-51-100
-101-200
Nova Scotia
Weight / Tow (kg)
1 - 20
21 - 50
51 - 100
101 - 500
501 +

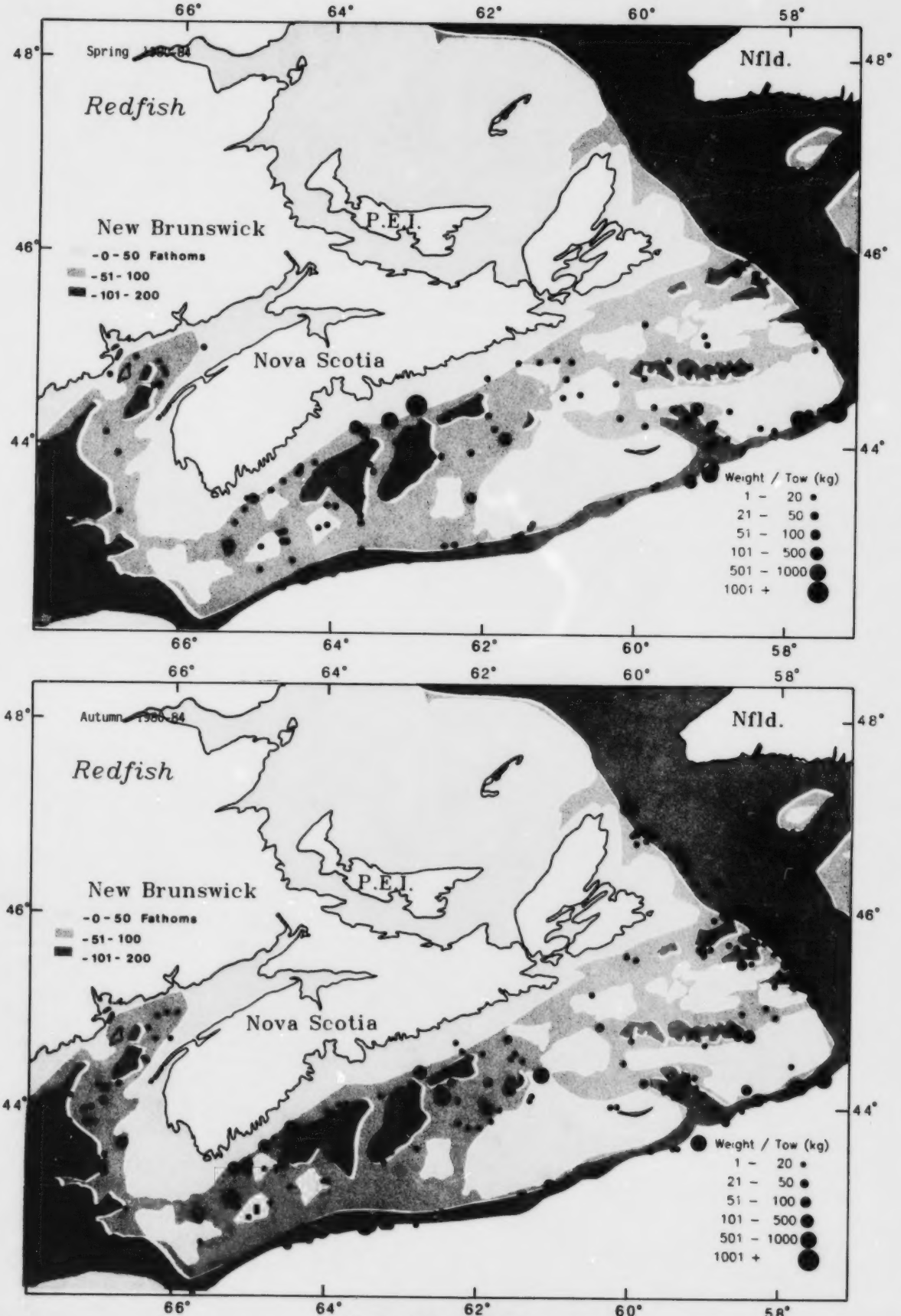
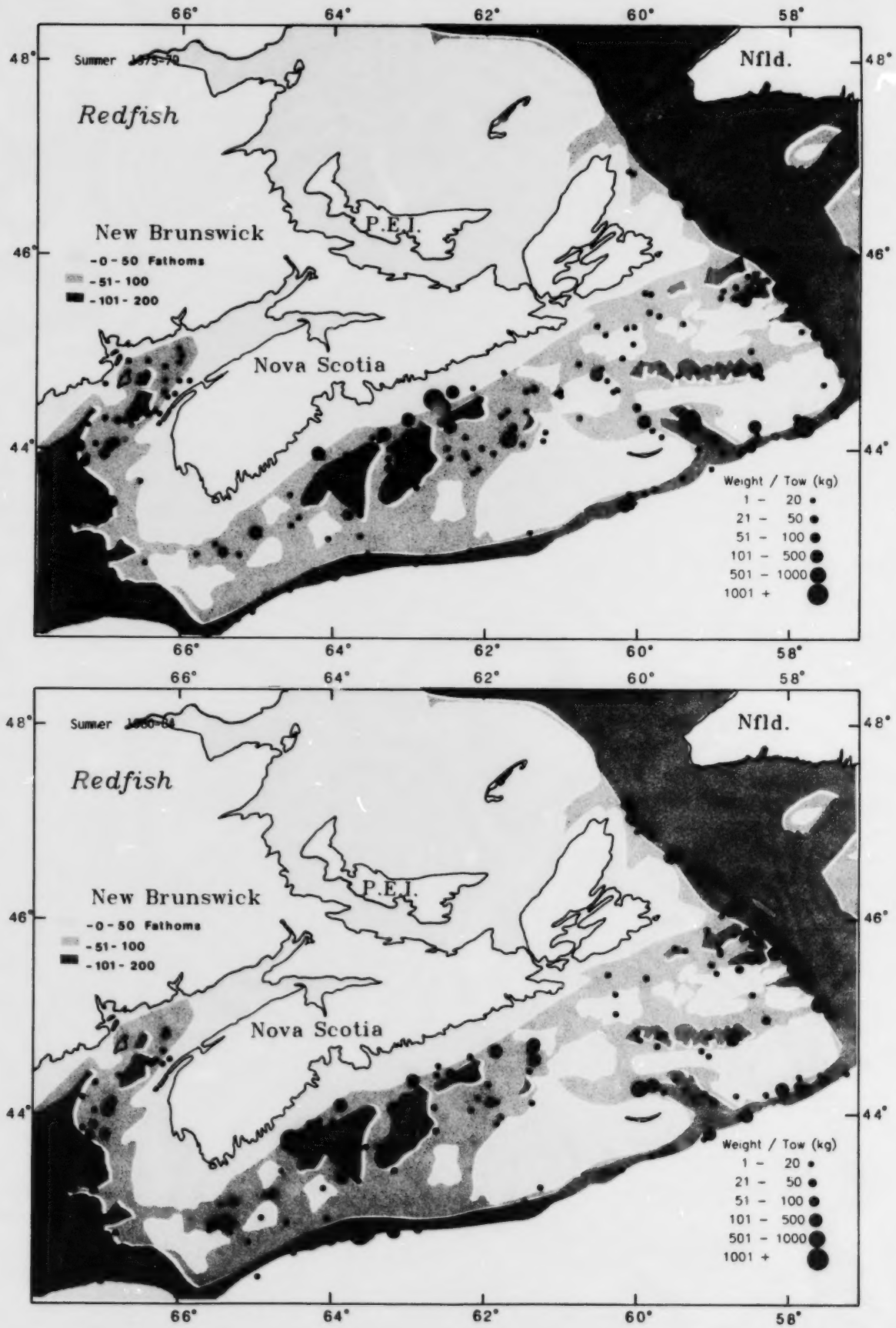


Fig. 21. Redfish (Sebastes marinus)


66°
64°
62°
60°
58°
48°
46°
44°
Summer
Redfish
Nfld.
P.E.I.
New Brunswick
-0-50 Fathoms
-51-100
-101-200
Nova Scotia
Weight / Tow (kg)
1 - 20
21 - 50
51 - 100
101 - 500
501 - 1000
1001 +

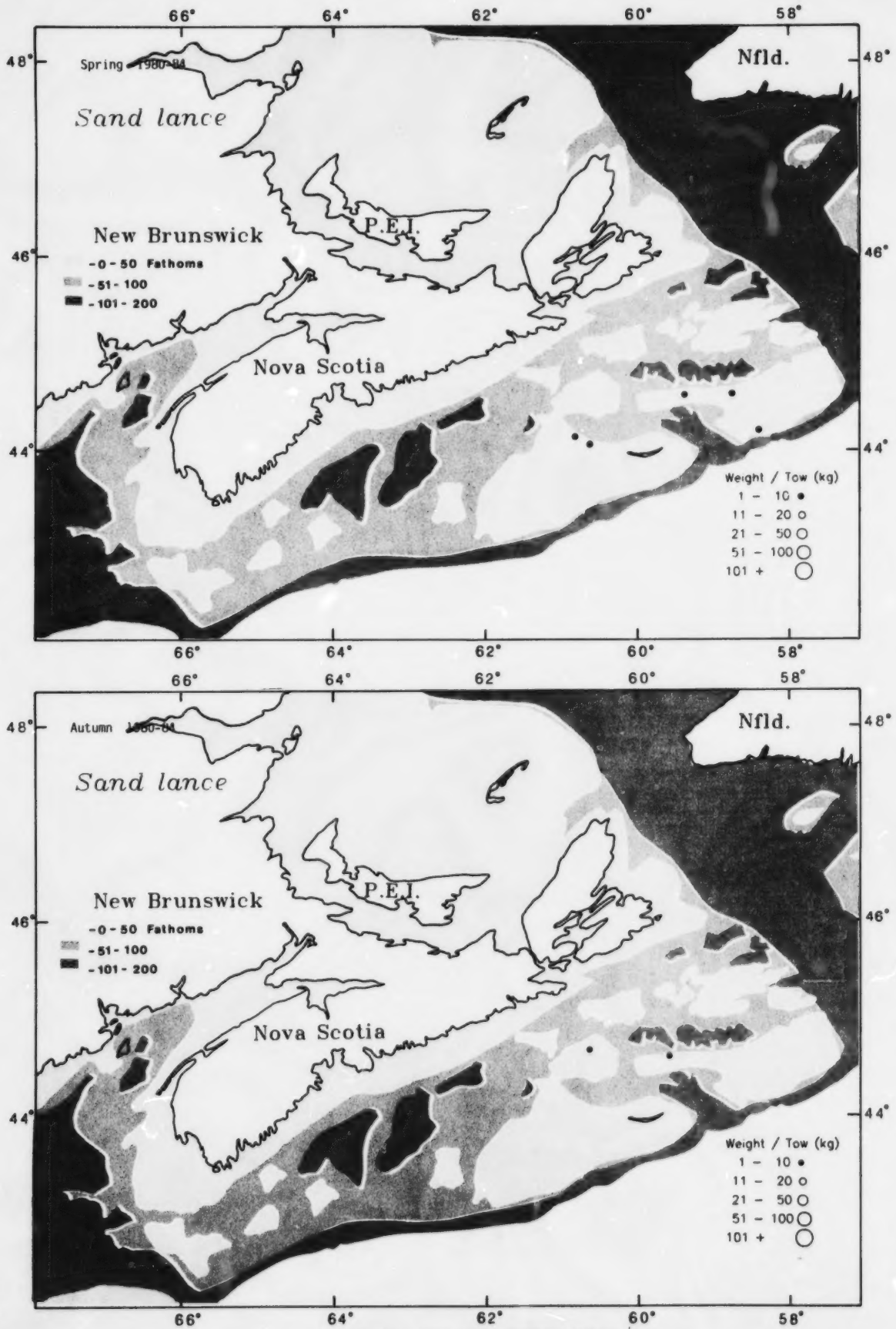
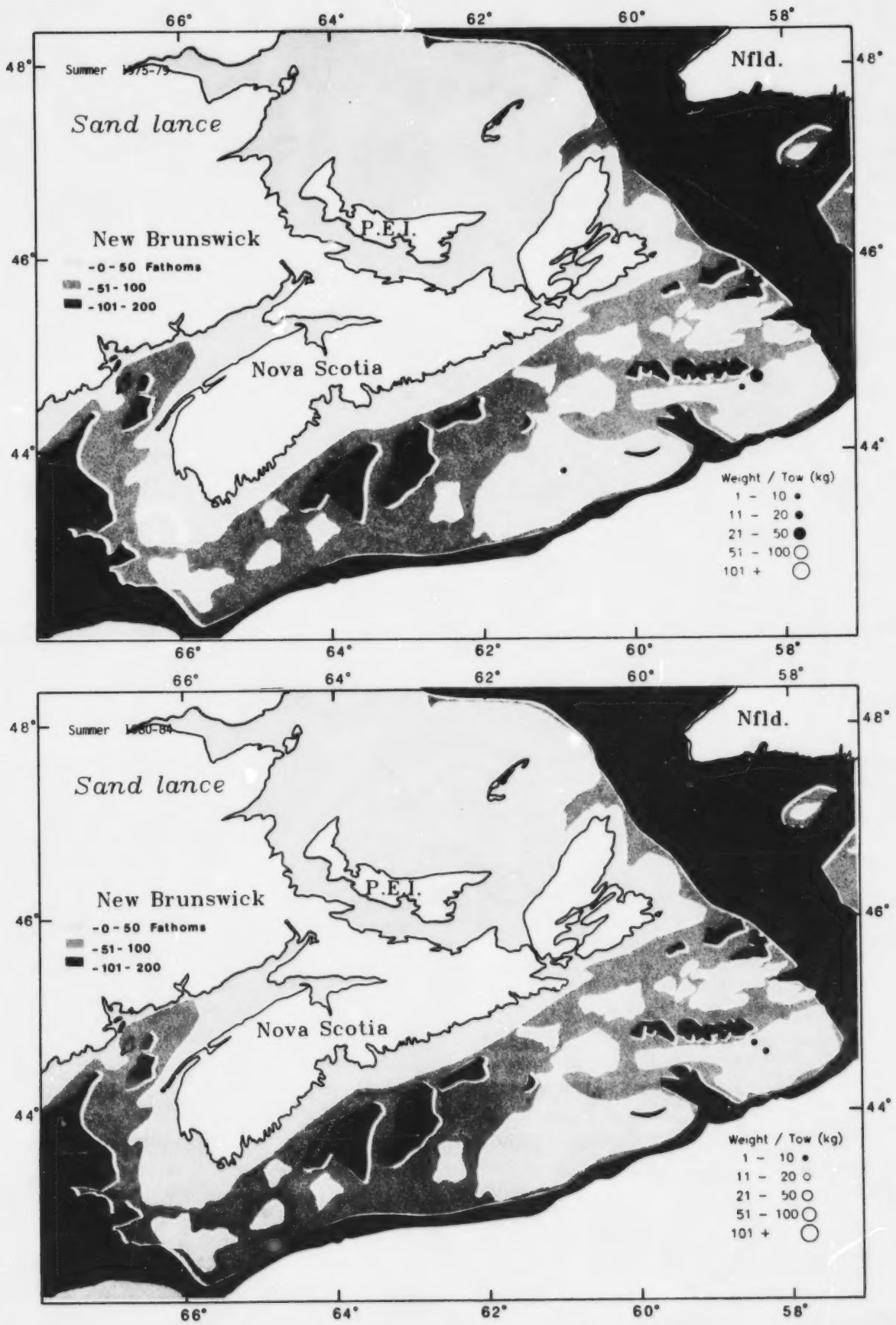


Fig. 22. Sand lance (Ammodytes dubius)


66°
64°
62°
60°
58°
48°
46°
44°
Summer 1975-79
Sand lance
Nfld.
P.E.I.
New Brunswick
-0-50 Fathoms
-51-100
-101-200
Nova Scotia
Weight / Tow (kg)
1 - 10
11 - 20
21 - 50
51 - 100
101 +
Summer 1980-84
Sand lance
Nfld.
P.E.I.
New Brunswick
-0-50 Fathoms
-51-100
-101-200
Nova Scotia
Weight / Tow (kg)
1 - 10
11 - 20
21 - 50
51 - 100
101 +

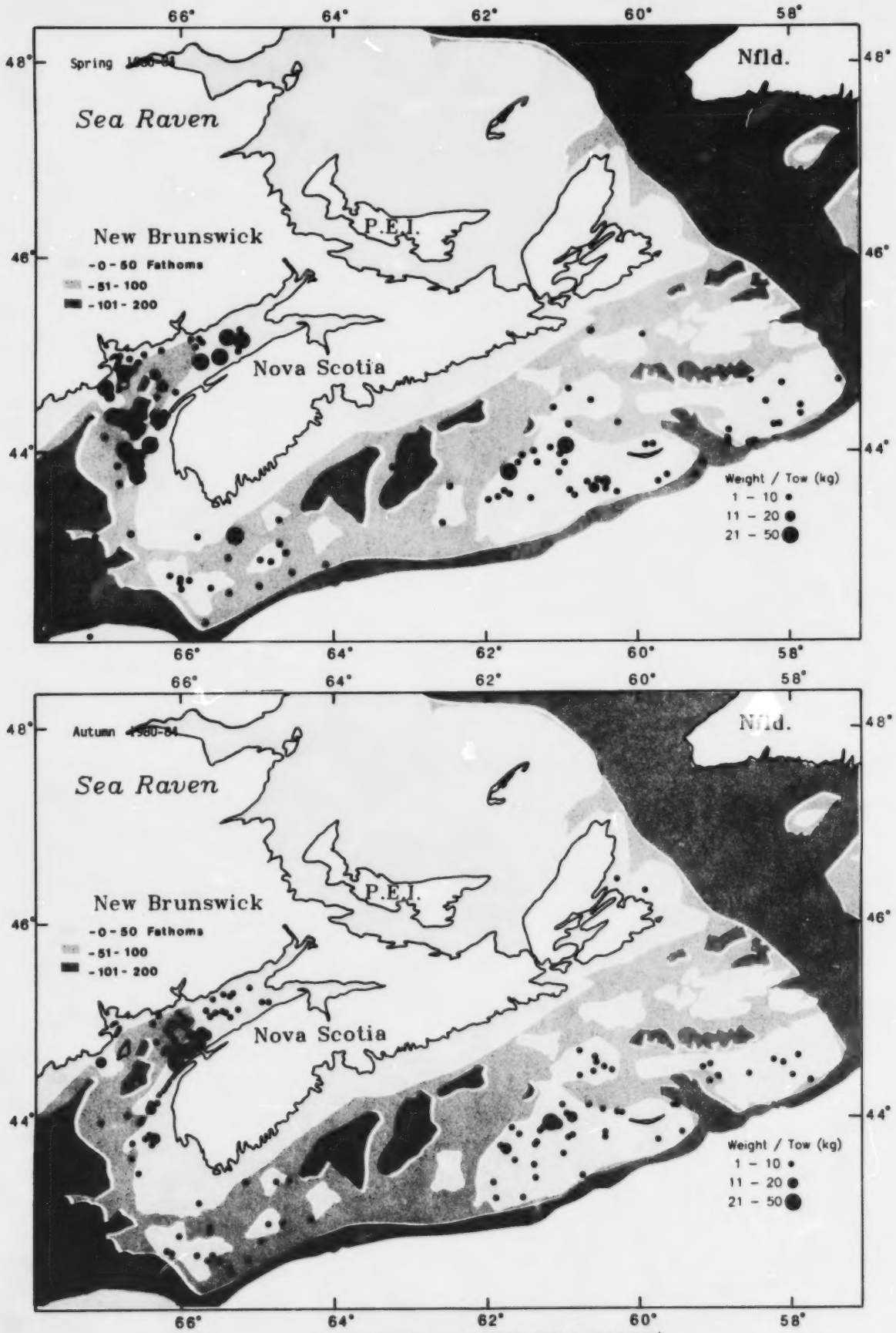
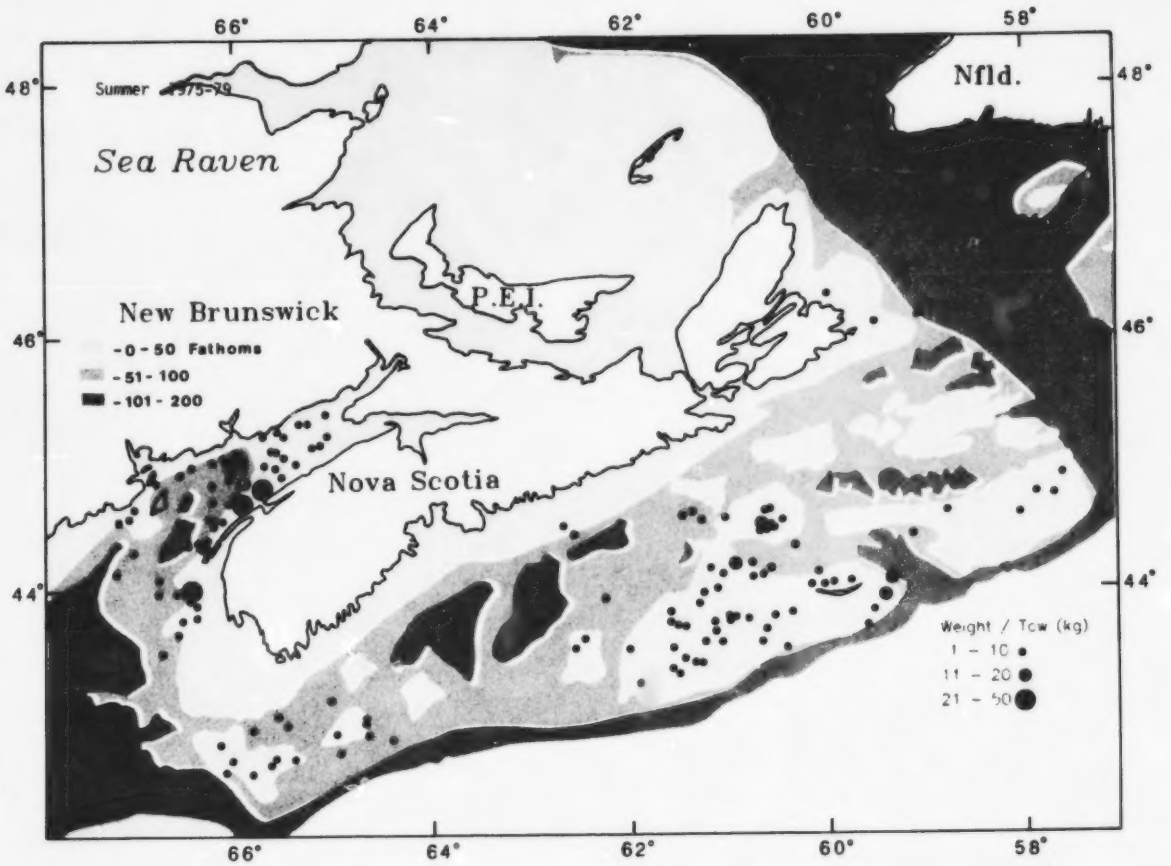
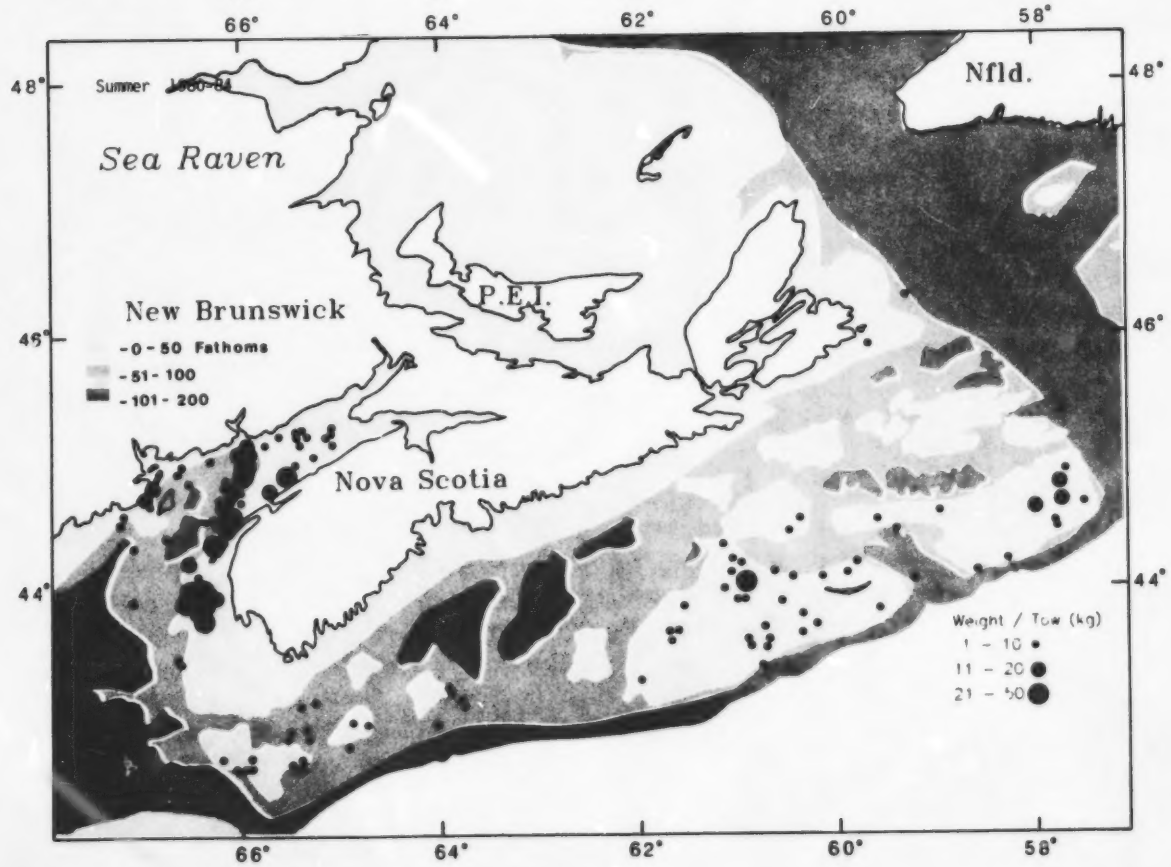


Fig. 23. Sea raven (Hemitripterus americanus)


66°
64°
62°
60°
58°
48°
46°
44°
Summer
Sea Raven
Nfld.
New Brunswick
P.E.I.
Nova Scotia
-0-50 Fathoms
-51-100
-101-200
Weight / Tow (kg)
1 - 10
11 - 20
21 - 50


66°
64°
62°
60°
58°
48°
46°
44°
Summer
Sea Raven
Nfld.
New Brunswick
P.E.I.
Nova Scotia
-0-50 Fathoms
-51-100
-101-200
Weight / Tow (kg)
1 - 10
11 - 20
21 - 50

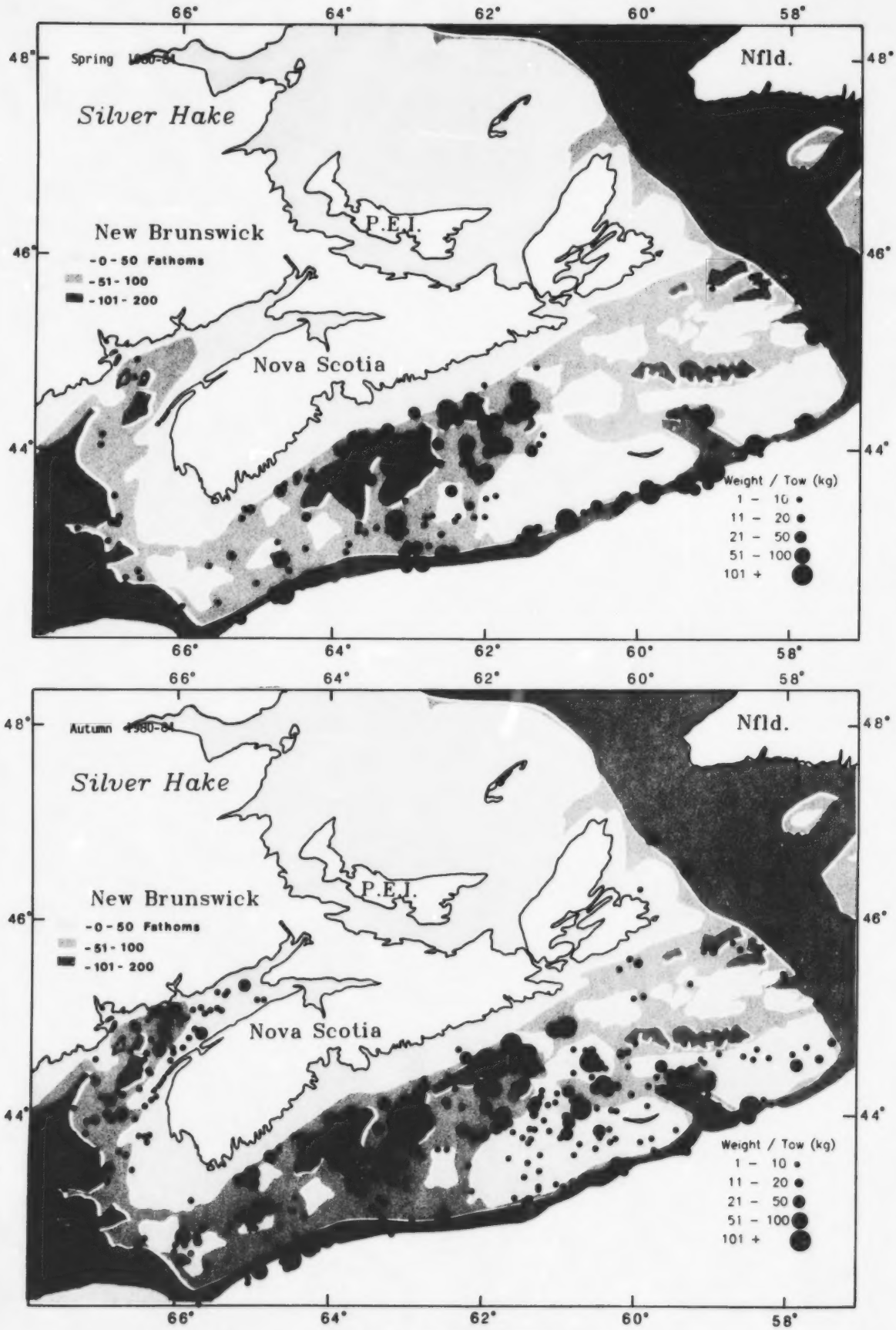
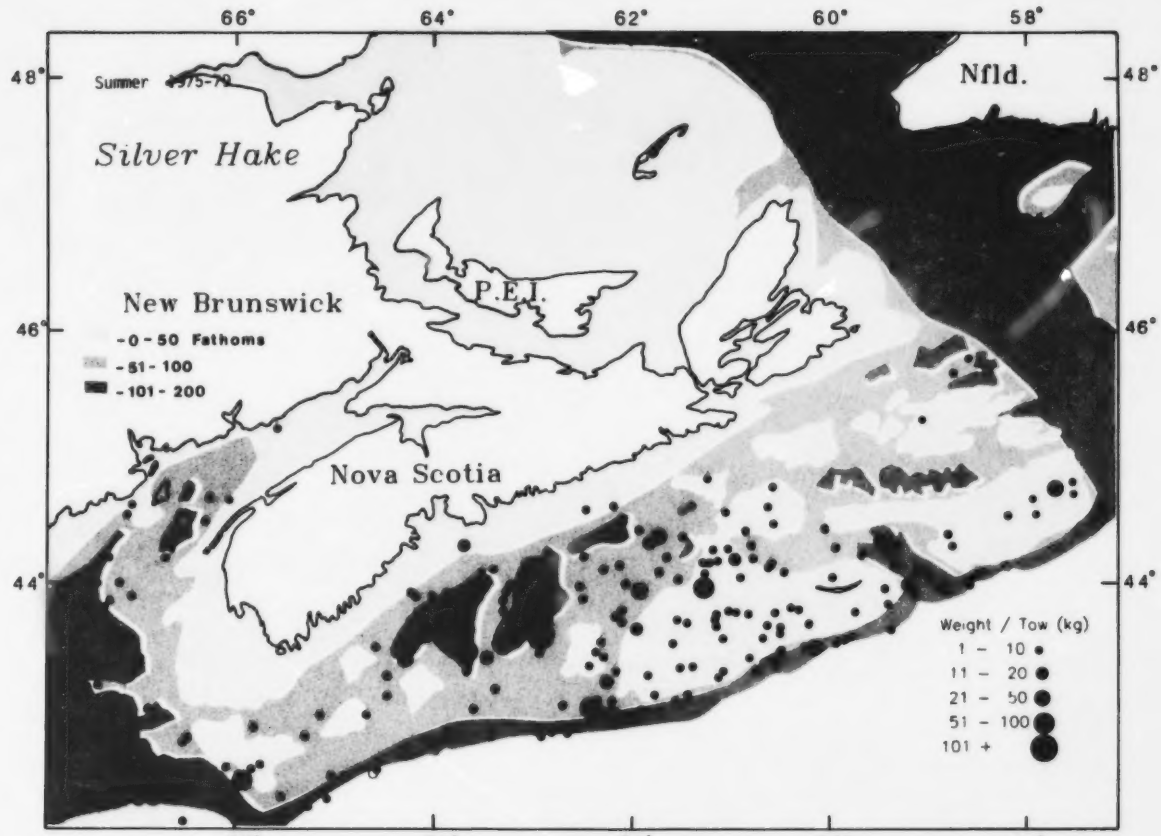
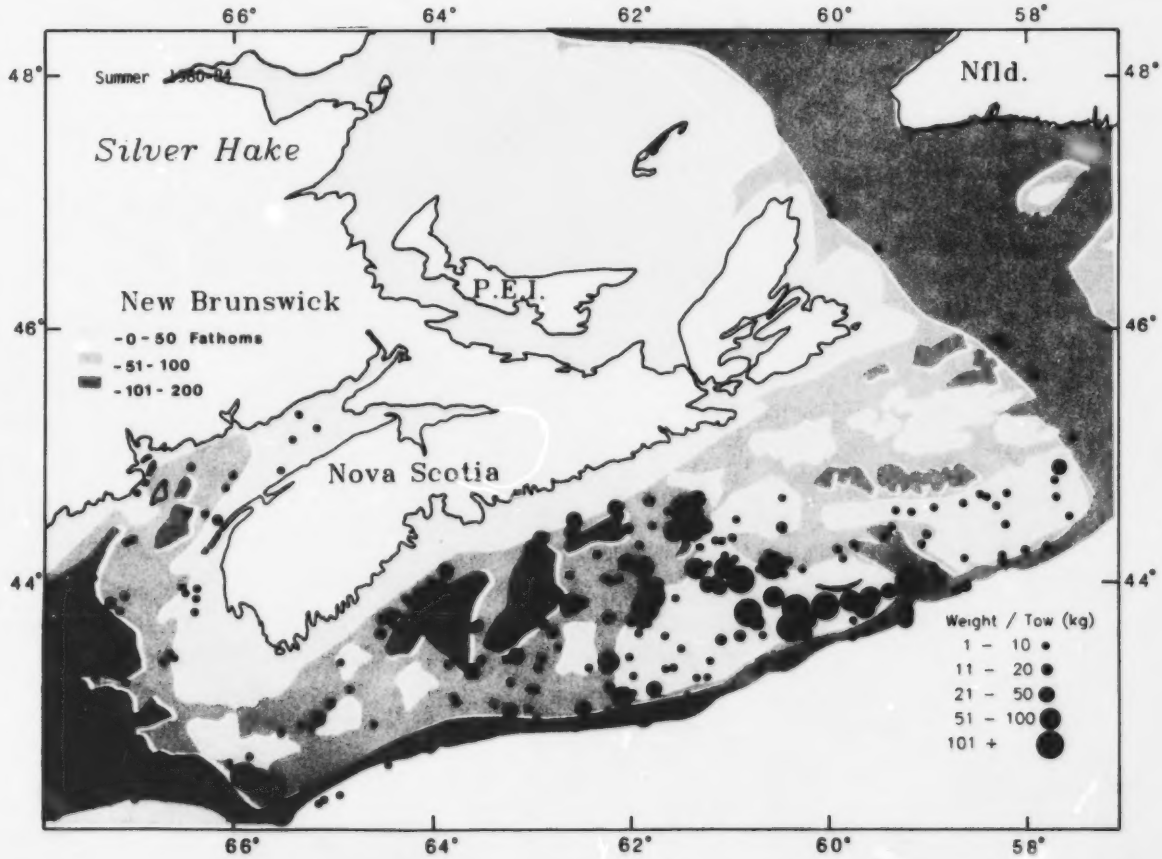


Fig. 24. Silver hake (Merluccius bilinearis)


66°
64°
62°
60°
58°
48°
46°
44°
Summer 1975-79
Silver Hake
Nfld.
New Brunswick
P.E.I.
Nova Scotia
-0-50 Fathoms
-51-100
-101-200
Weight / Tow (kg)
1 - 10
11 - 20
21 - 50
51 - 100
101 +


66°
64°
62°
60°
58°
48°
46°
44°
Summer 1980-84
Silver Hake
Nfld.
New Brunswick
P.E.I.
Nova Scotia
-0-50 Fathoms
-51-100
-101-200
Weight / Tow (kg)
1 - 10
11 - 20
21 - 50
51 - 100
101 +

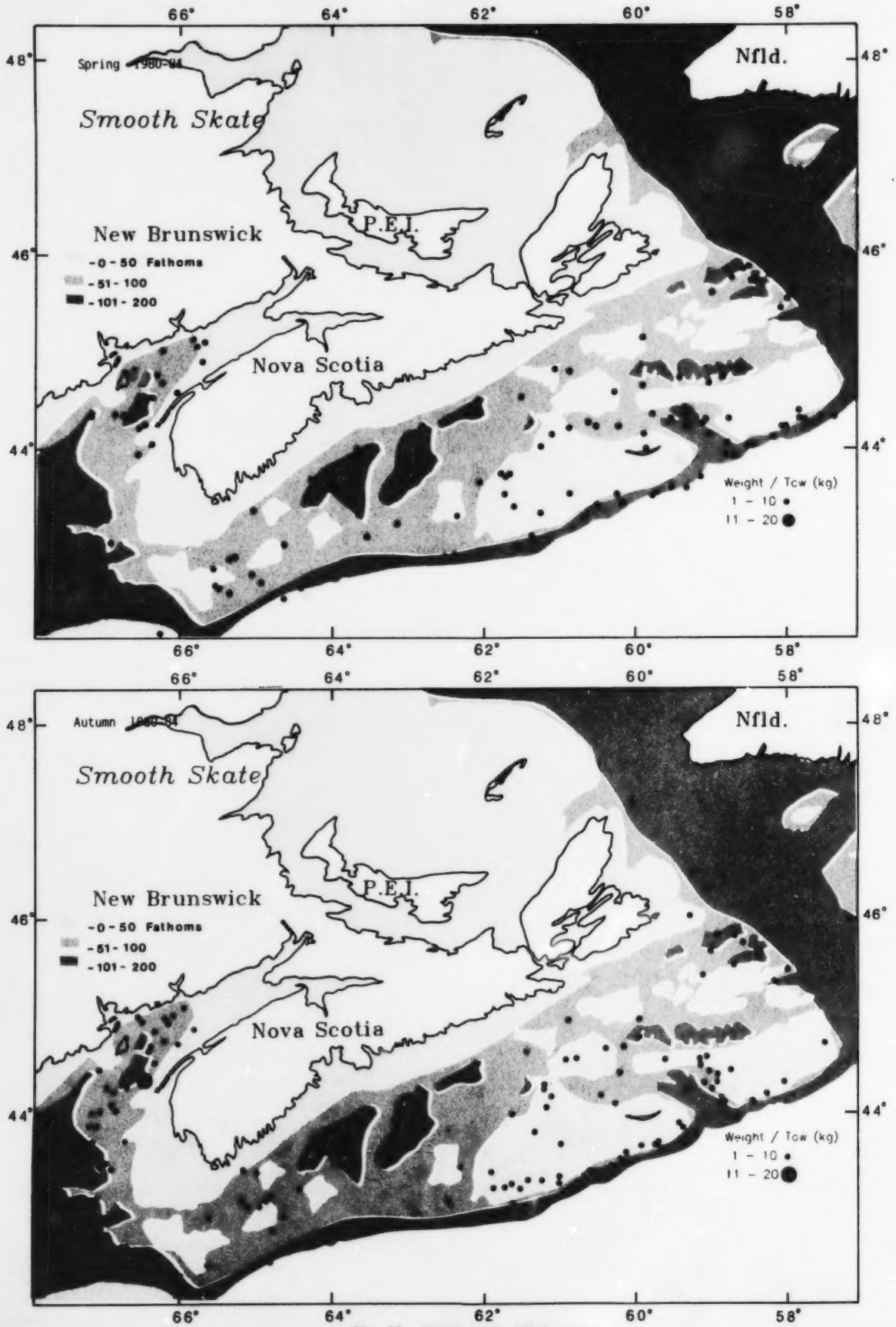
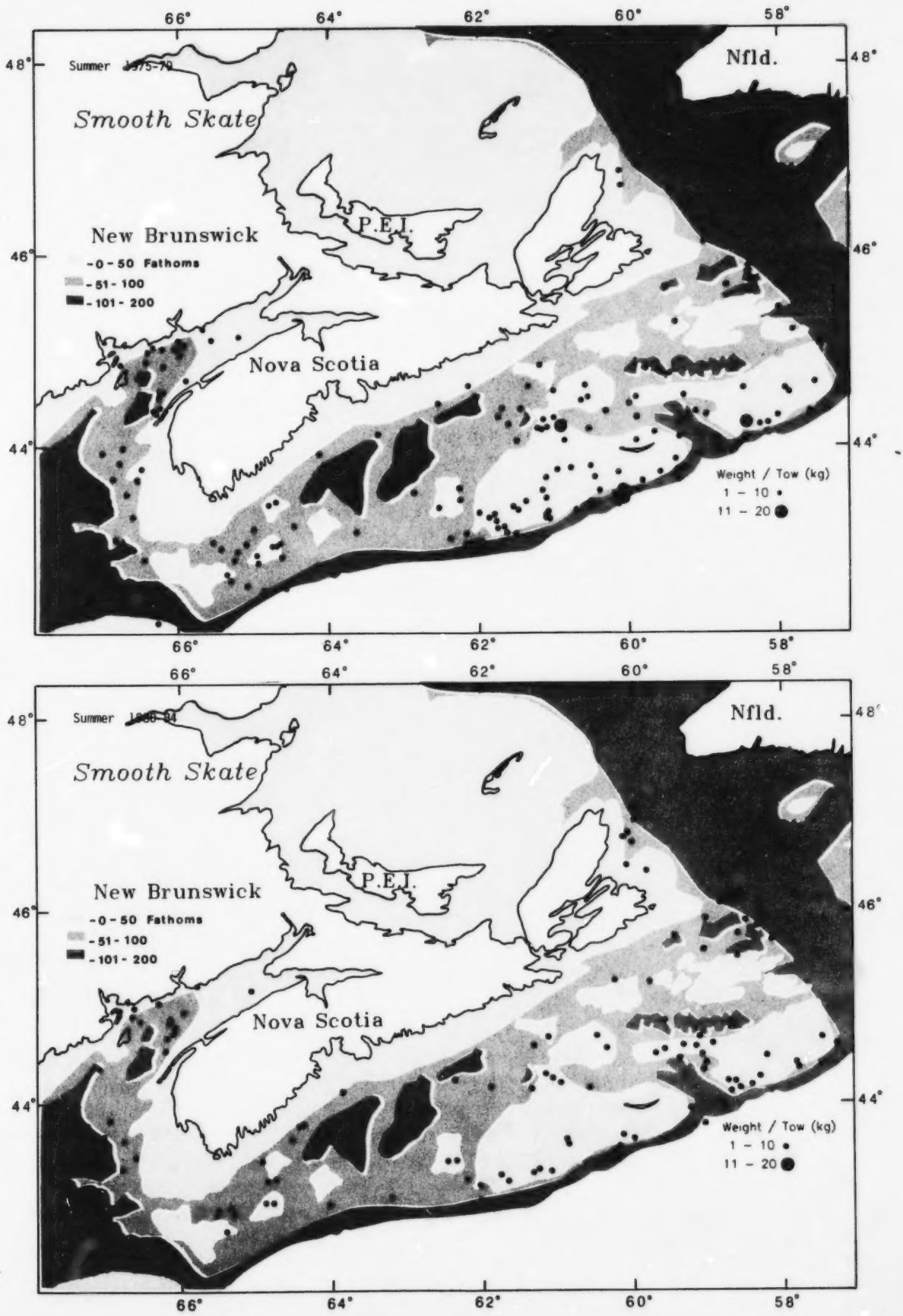


Fig. 25. Smooth skate (Raja senta)


66°
64°
62°
60°
58°
48°
46°
44°
Summer 1975-79
Smooth Skate
Nfld.
P.E.I.
New Brunswick
-0-50 Fathoms
-51-100
-101-200
Nova Scotia
Weight / Tow (kg)
1 - 10
11 - 20
Summer 1980-84
Smooth Skate
Nfld.
P.E.I.
New Brunswick
-0-50 Fathoms
-51-100
-101-200
Nova Scotia
Weight / Tow (kg)
1 - 10
11 - 20

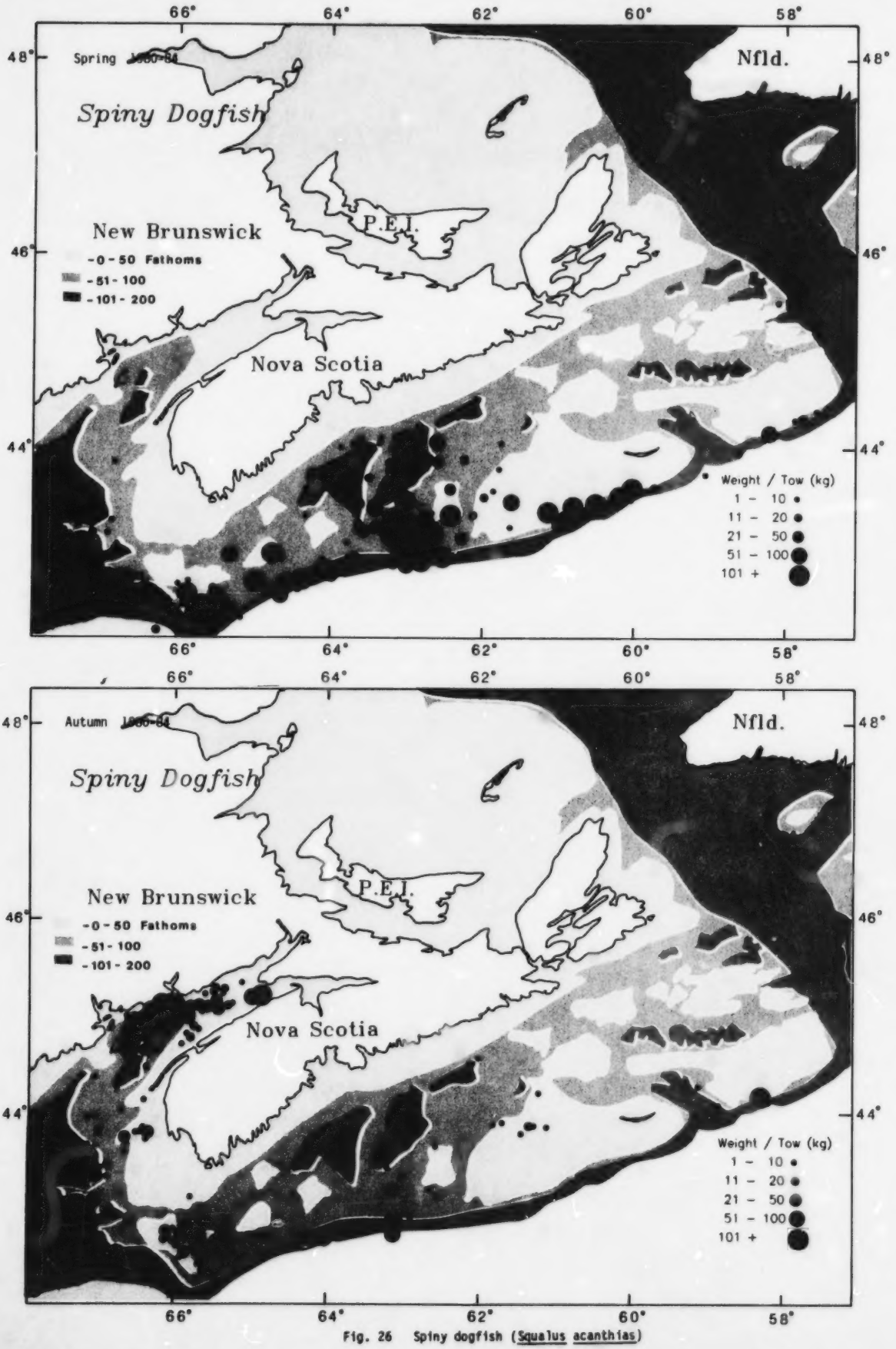
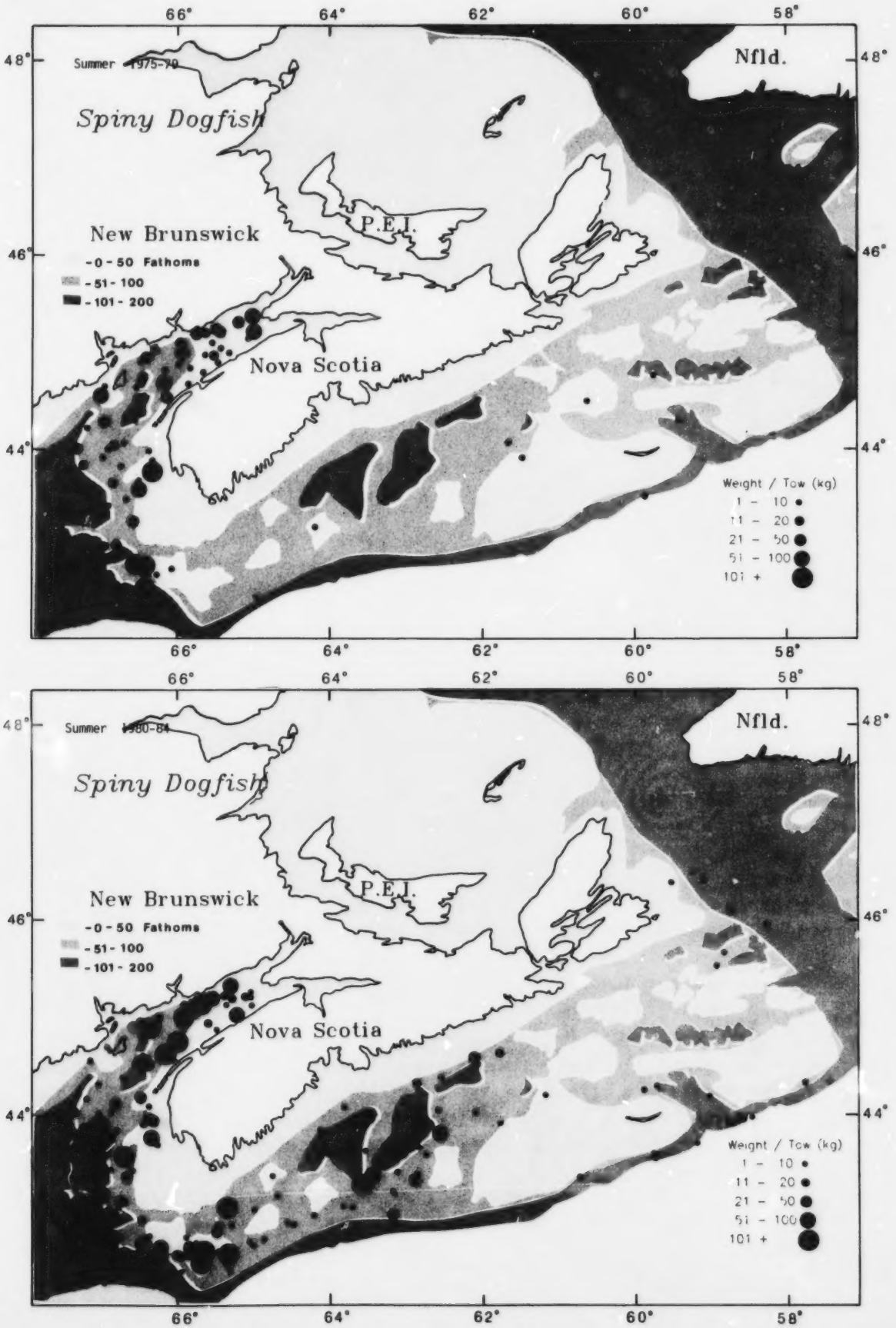


Fig. 26 Spiny dogfish (Squalus acanthias)


66°
64°
62°
60°
58°
48°
46°
44°
Summer 1975-79
Spiny Dogfish
Nfld.
P.E.I.
New Brunswick
-0-50 Fathoms
-51-100
-101-200
Nova Scotia
Weight / Tow (kg)
1 - 10
11 - 20
21 - 50
51 - 100
101 +
Summer 1980-84
Spiny Dogfish
Nfld.
P.E.I.
New Brunswick
-0-50 Fathoms
-51-100
-101-200
Nova Scotia
Weight / Tow (kg)
1 - 10
11 - 20
21 - 50
51 - 100
101 +

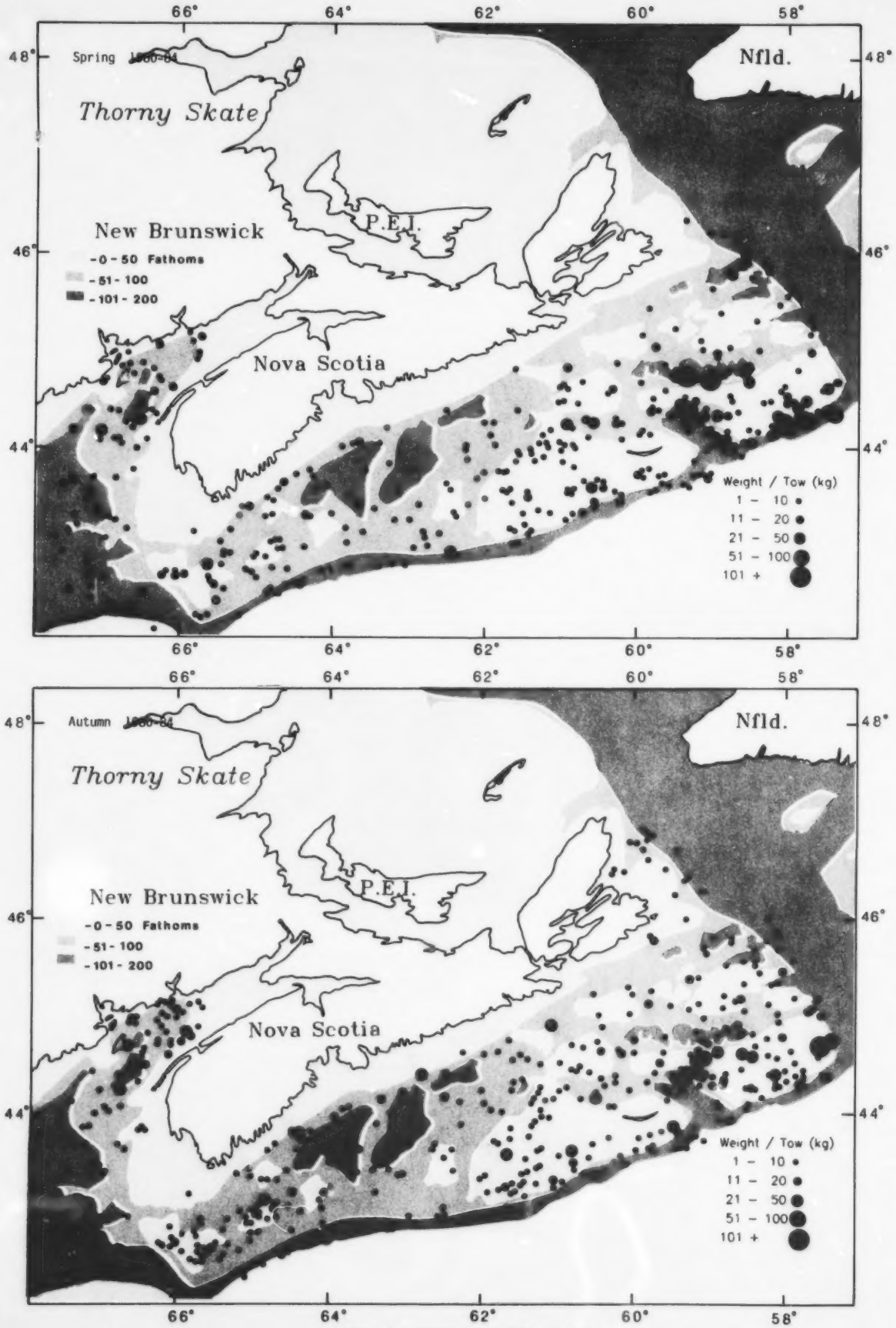
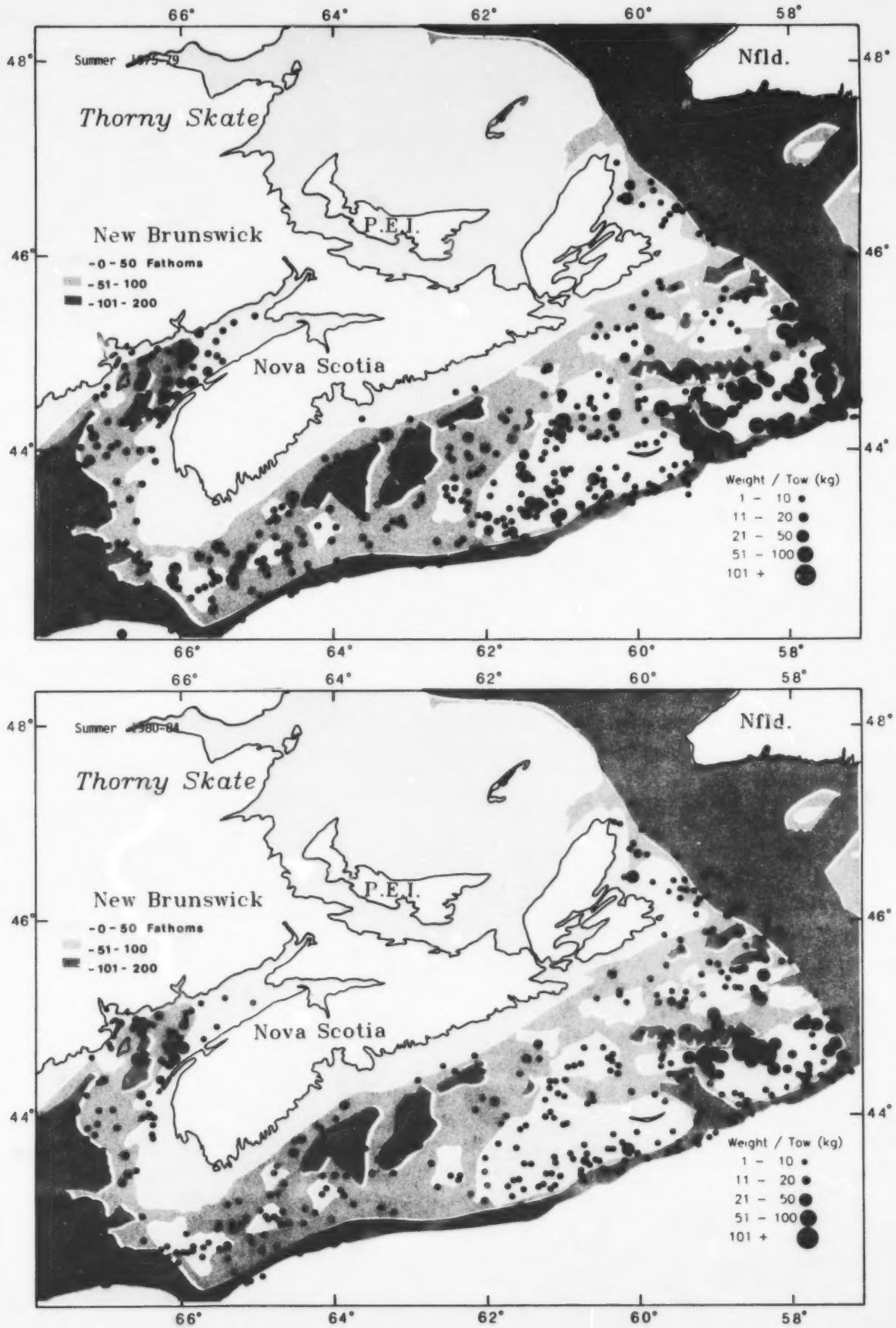


Fig. 27. Thorny skate (Raja radiata)


66°
64°
62°
60°
58°
48°
46°
44°
Summer 1975-79
Thorny Skate
Nfld.
P.E.I.
New Brunswick
-0-50 Fathoms
-51-100
-101-200
Nova Scotia
Weight / Tow (kg)
1 - 10
11 - 20
21 - 50
51 - 100
101 +
Summer 1980-84
Thorny Skate
Nfld.
P.E.I.
New Brunswick
-0-50 Fathoms
-51-100
-101-200
Nova Scotia
Weight / Tow (kg)
1 - 10
11 - 20
21 - 50
51 - 100
101 +

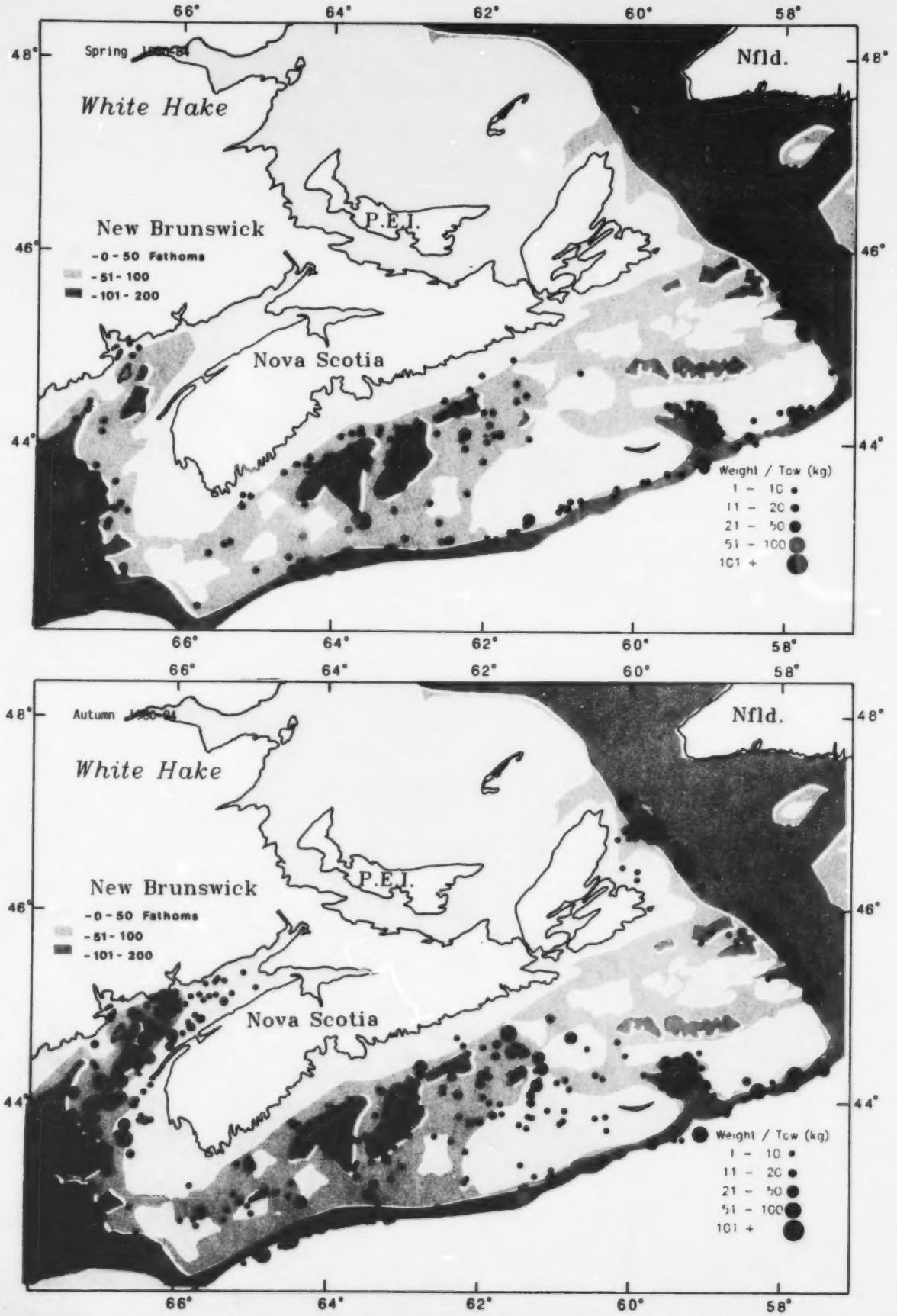
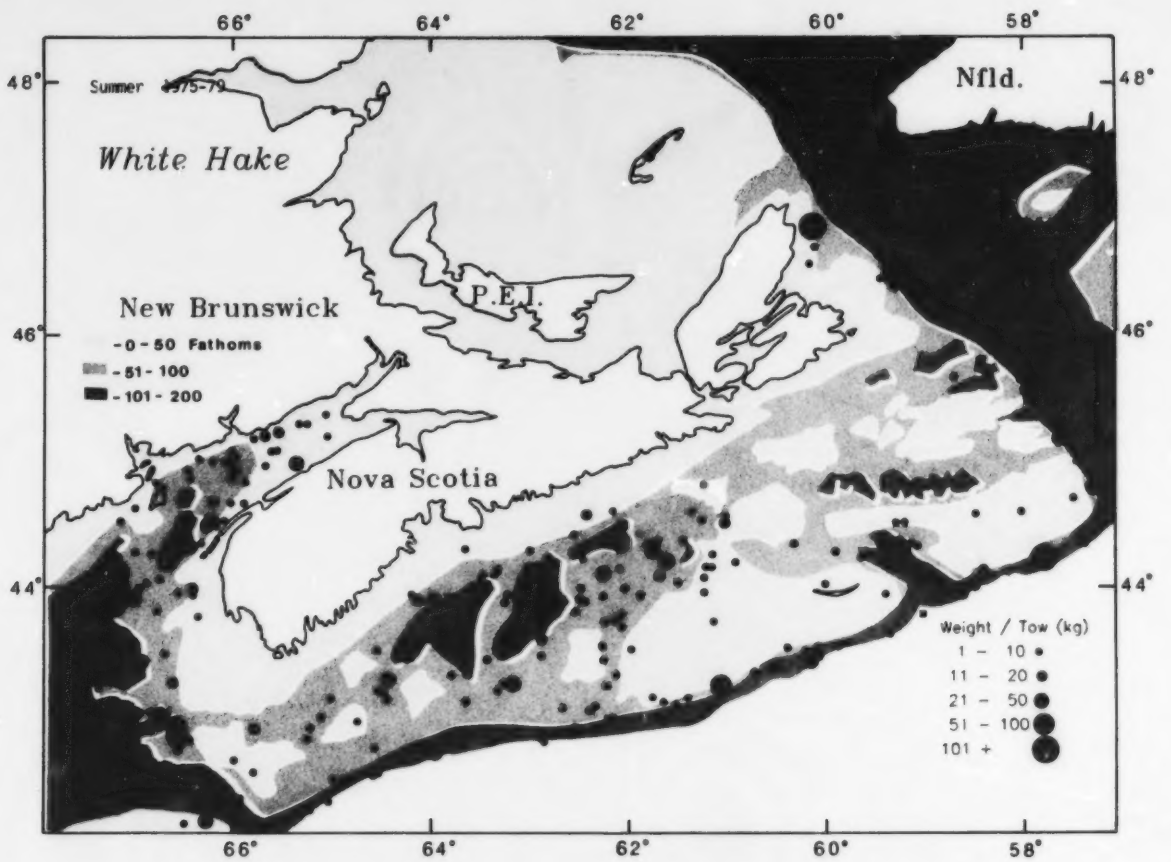
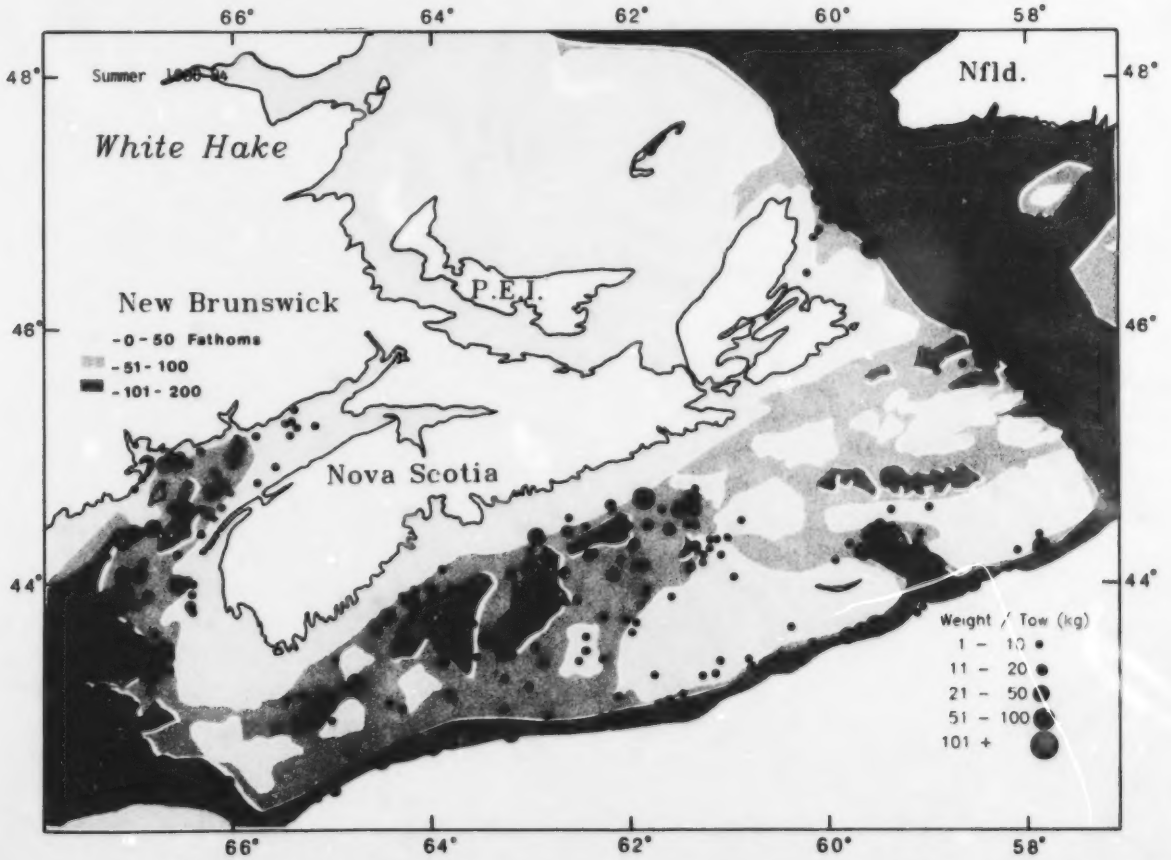


Fig. 28. White hake (Urophycis tenuis)


66°
64°
62°
60°
58°
48°
46°
44°
Summer 1975-79
White Hake
Nfld.
P.E.I.
New Brunswick
-0-50 Fathoms
-51-100
-101-200
Nova Scotia
Weight / Tow (kg)
1 - 10
11 - 20
21 - 50
51 - 100
101 +


66°
64°
62°
60°
58°
48°
46°
44°
Summer 1980-84
White Hake
Nfld.
P.E.I.
New Brunswick
-0-50 Fathoms
-51-100
-101-200
Nova Scotia
Weight / Tow (kg)
1 - 10
11 - 20
21 - 50
51 - 100
101 +

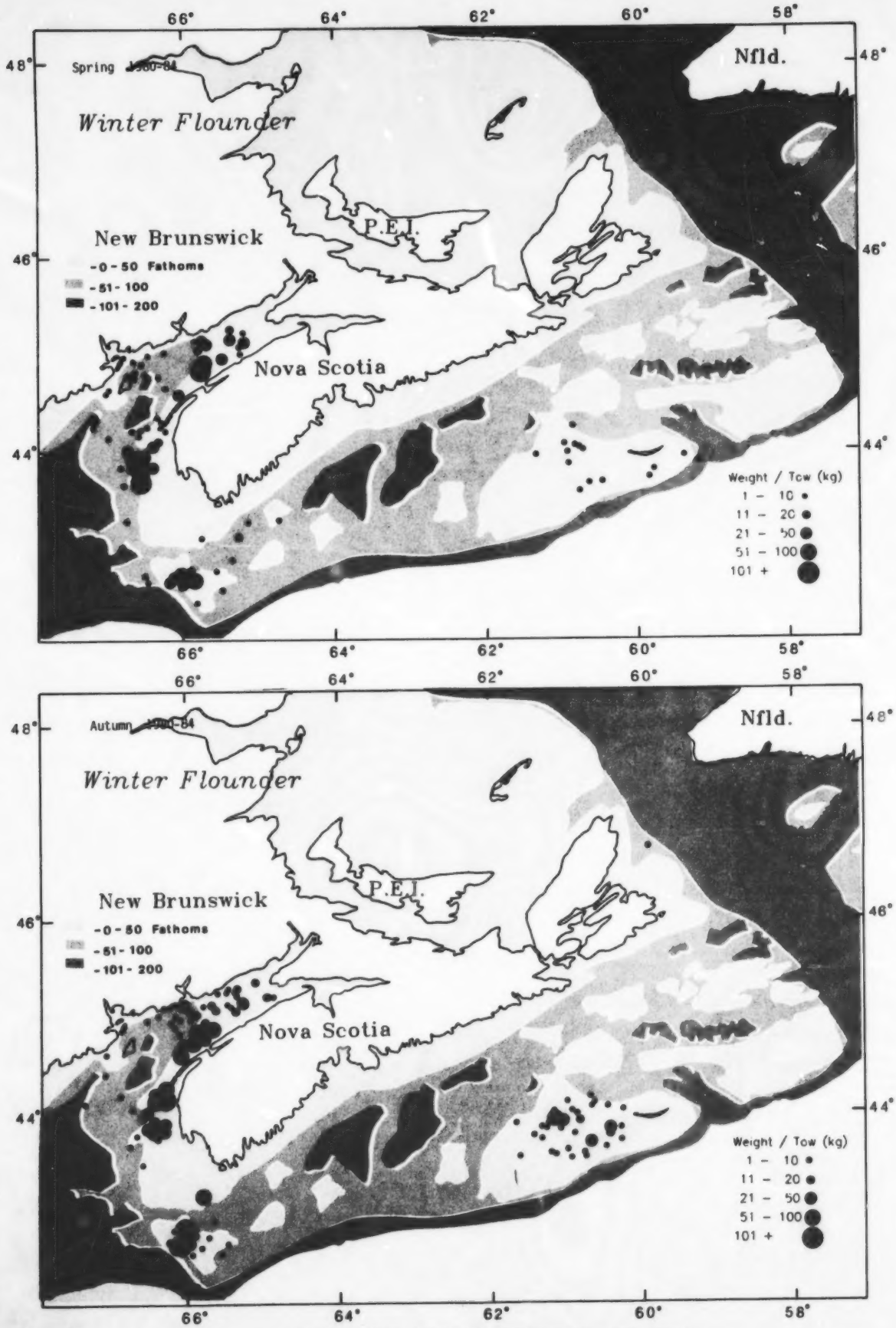
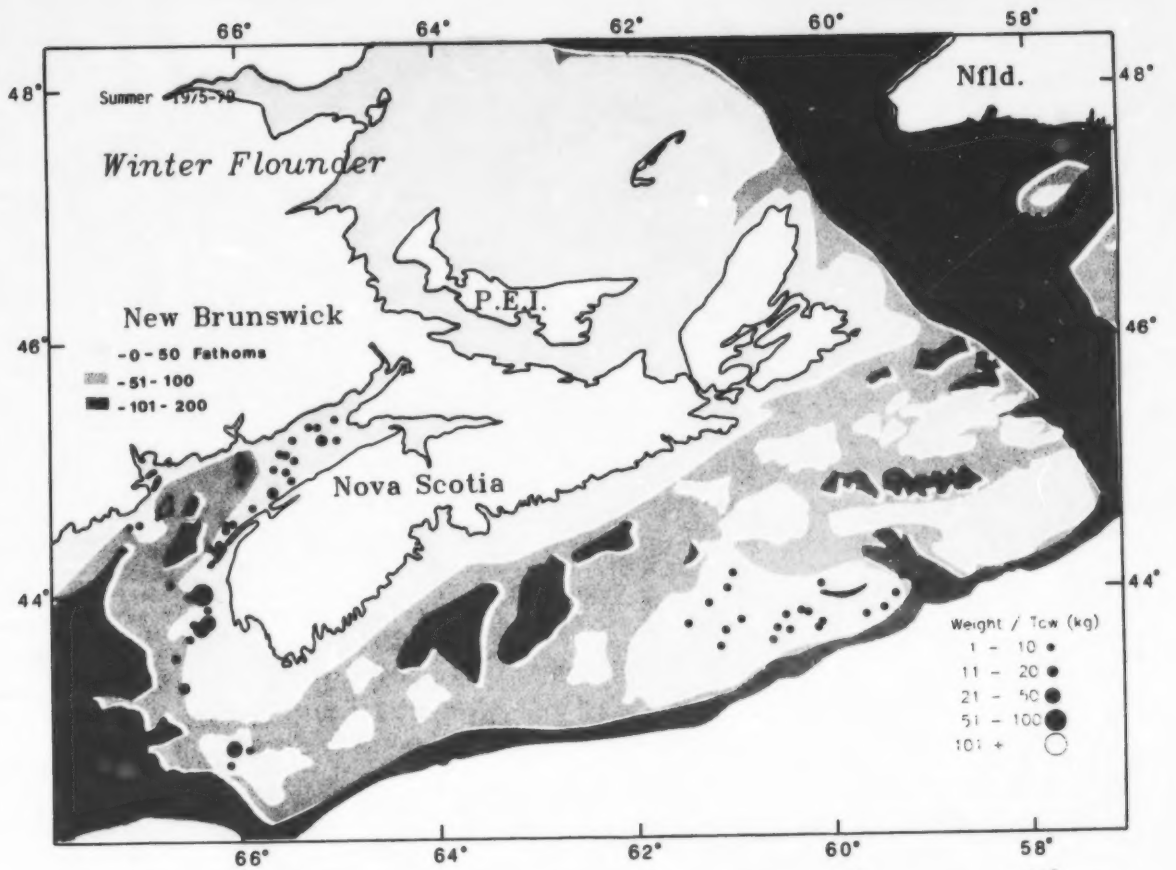
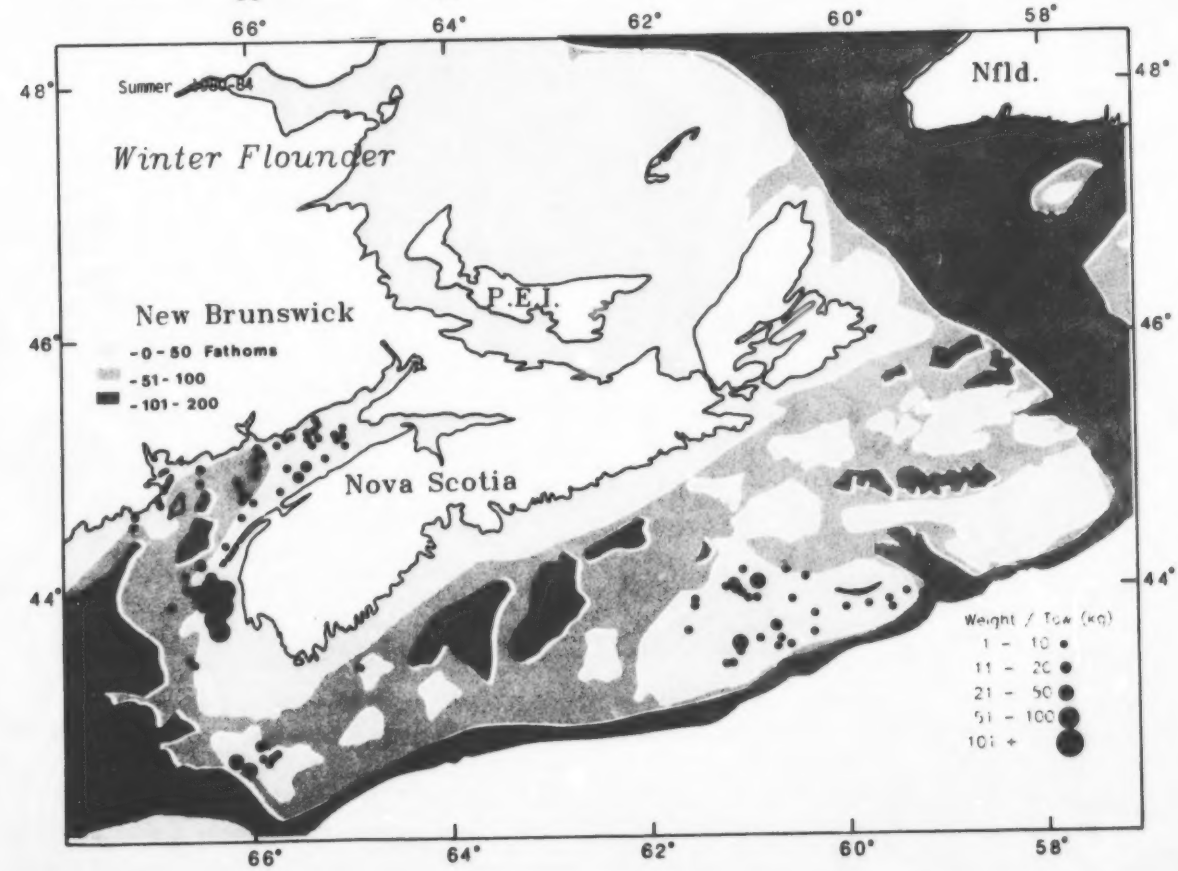


Fig. 29. Winter flounder (Pseudopleuronectes americanus)


66°
64°
62°
60°
58°
48°
46°
44°
Summer 1975-79
Winter Flounder
Nfld.
P.E.I.
New Brunswick
-0-50 Fathoms
-51-100
-101-200
Nova Scotia
Weight / Tow (kg)
1 - 10
11 - 20
21 - 50
51 - 100
101 +


66°
64°
62°
60°
58°
48°
46°
44°
Summer 1980-84
Winter Flounder
Nfld.
P.E.I.
New Brunswick
-0-50 Fathoms
-51-100
-101-200
Nova Scotia
Weight / Tow (kg)
1 - 10
11 - 20
21 - 50
51 - 100
101 +

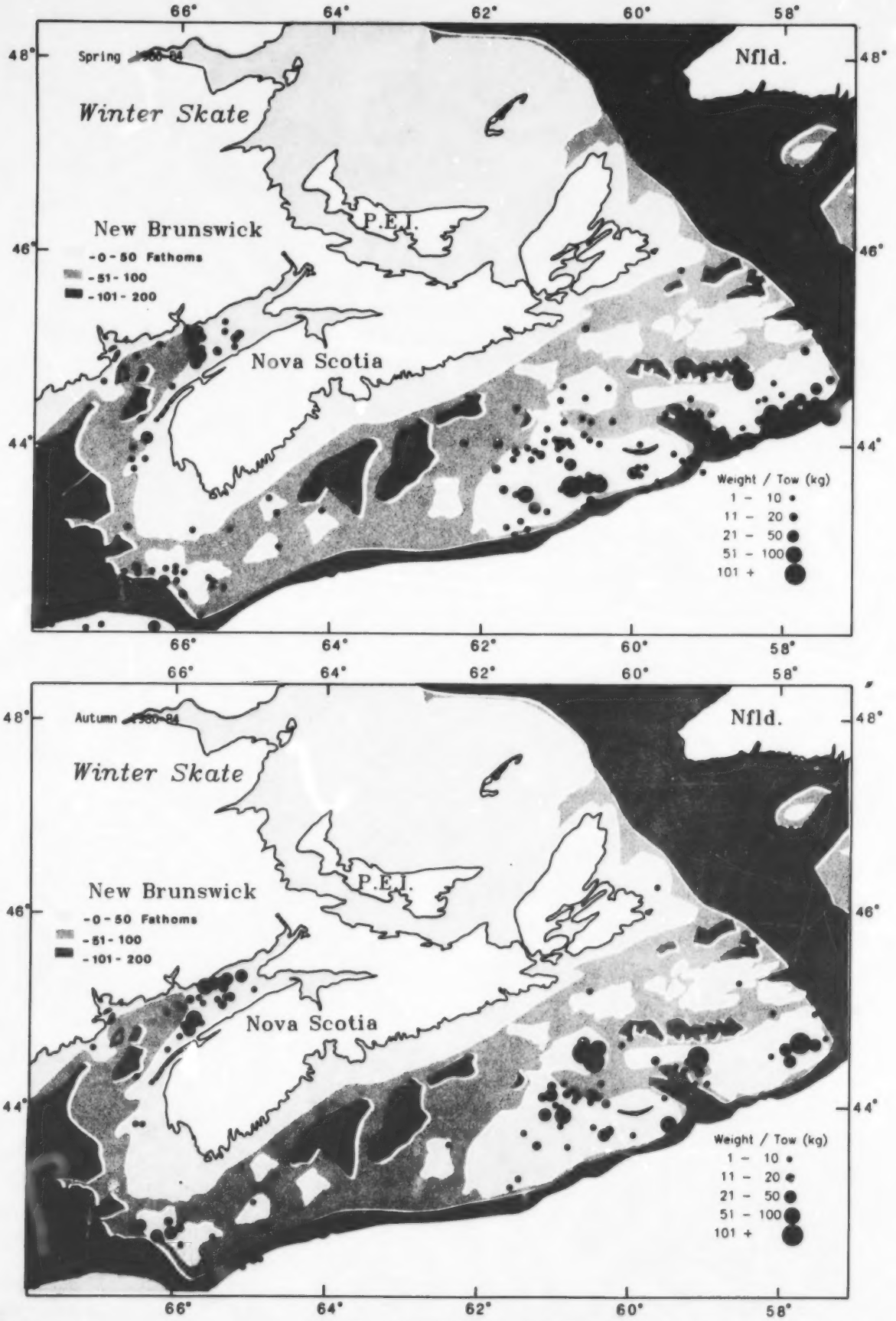
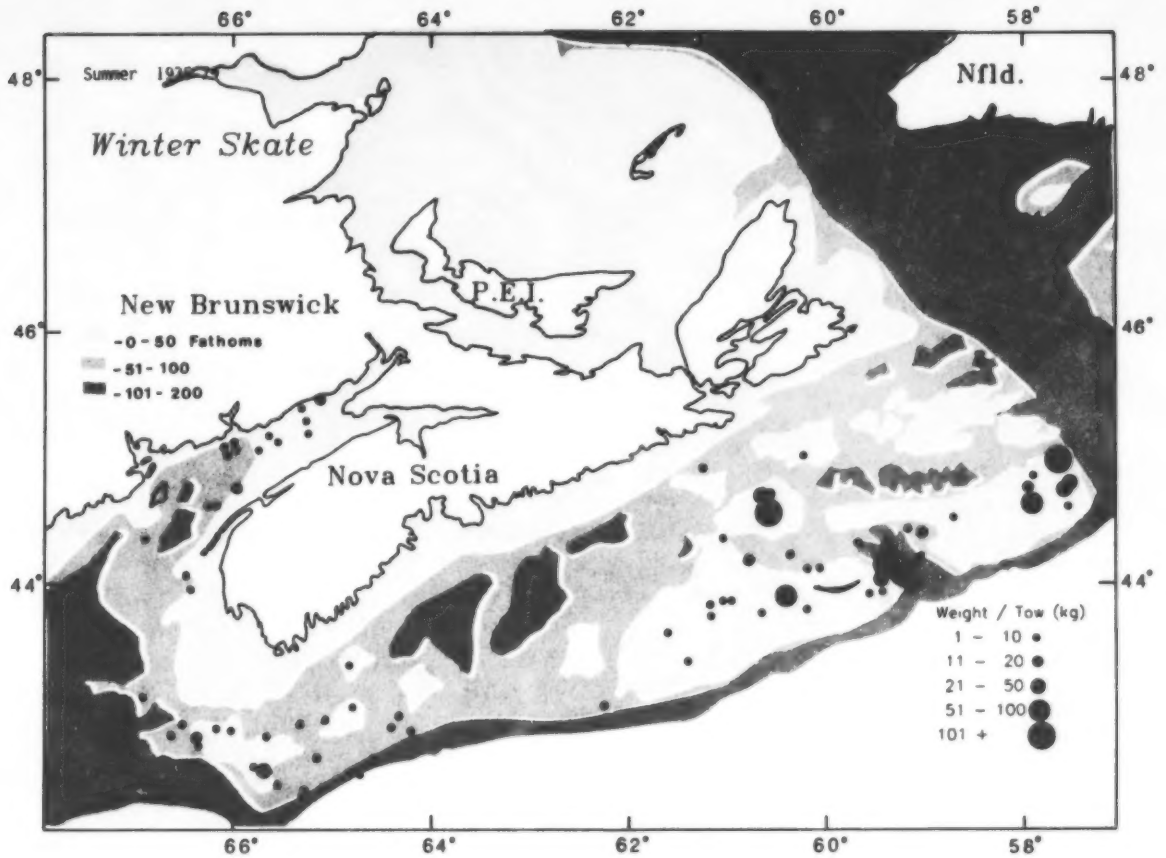
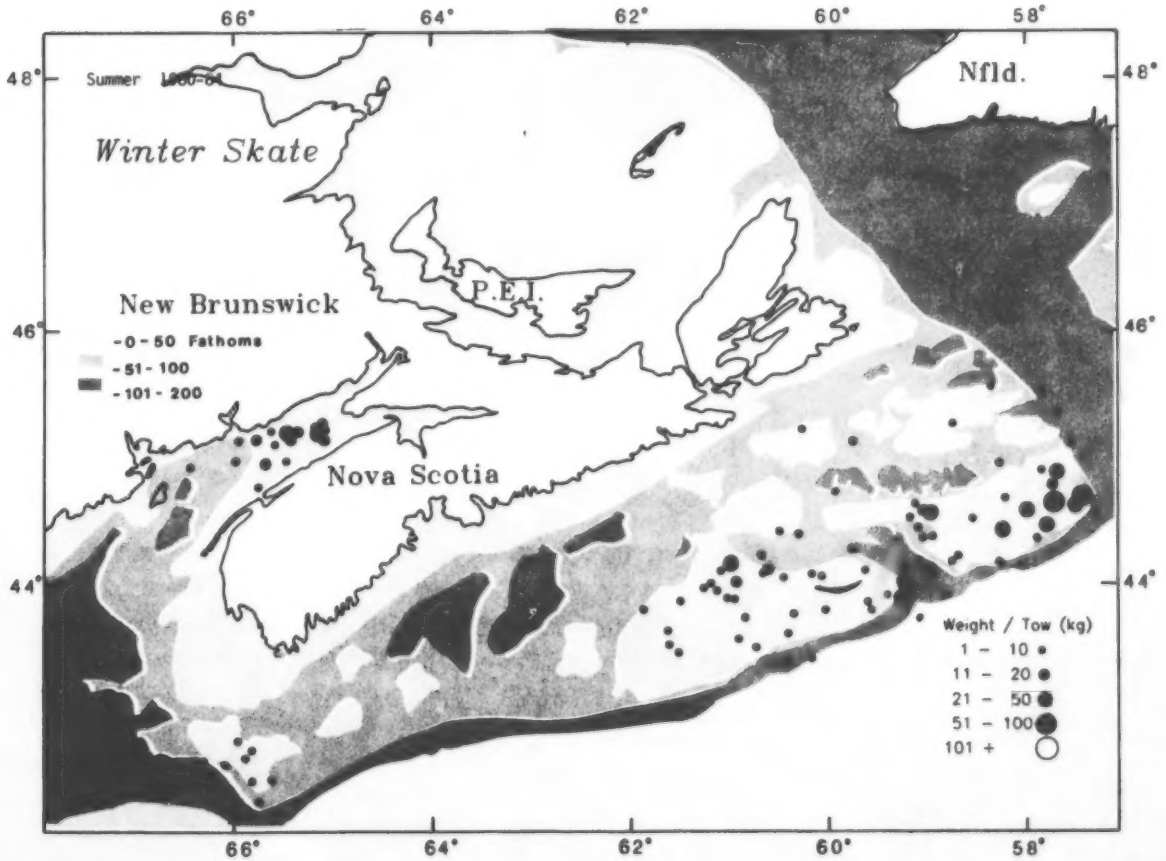


Fig. 30. Winter (eyed) skate (Raja ocellata)


66°
64°
62°
60°
58°
48°
46°
44°
Summer
Winter Skate
Nfld.
P.E.I.
New Brunswick
-0-50 Fathoms
-51-100
-101-200
Nova Scotia
Weight / Tow (kg)
1 - 10
11 - 20
21 - 50
51 - 100
101 +


66°
64°
62°
60°
58°
48°
46°
44°
Summer
Winter Skate
Nfld.
P.E.I.
New Brunswick
-0-50 Fathoms
-51-100
-101-200
Nova Scotia
Weight / Tow (kg)
1 - 10
11 - 20
21 - 50
51 - 100
101 +

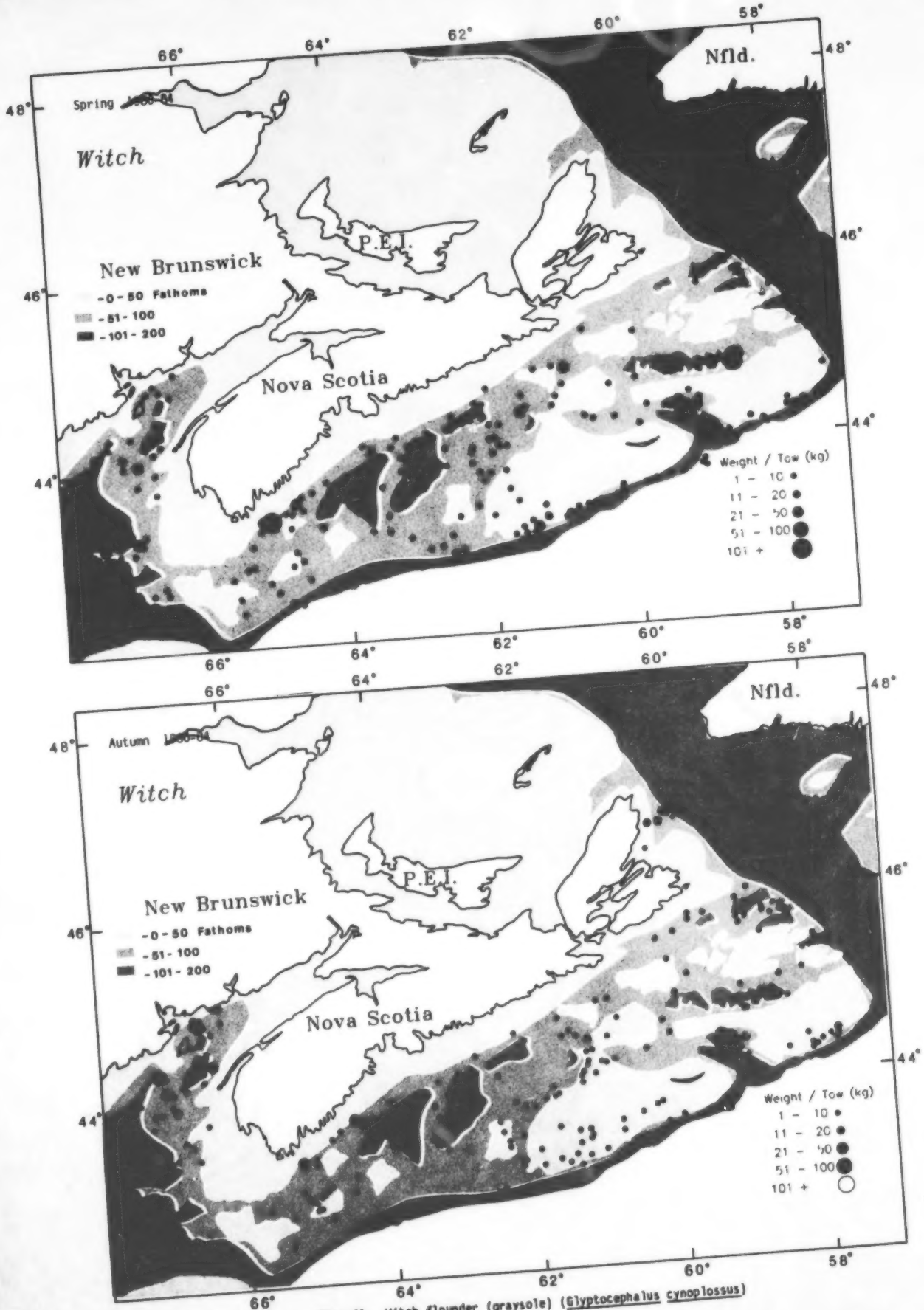
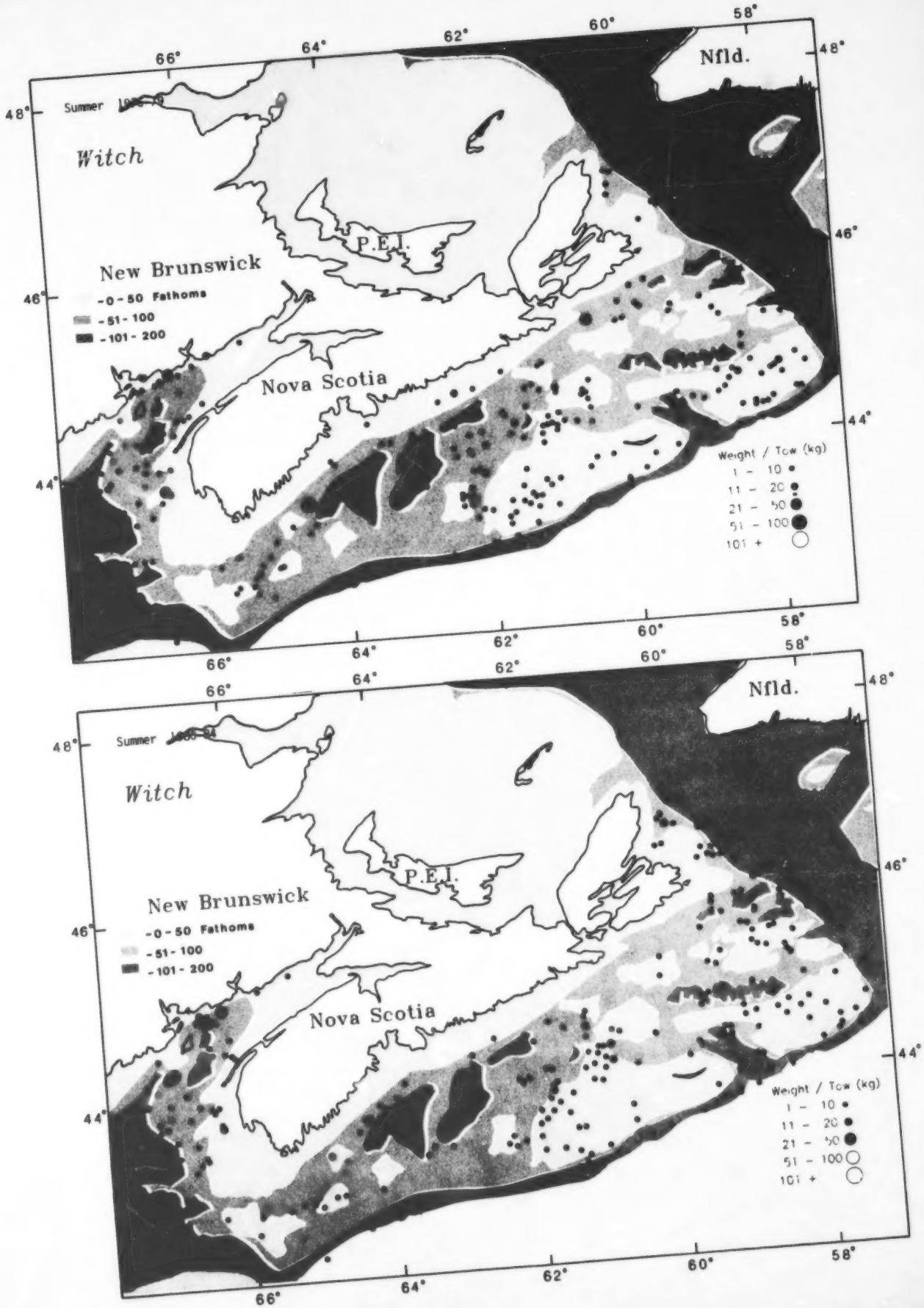


Fig. 31. Witch flounder (graysole) (Glyptocephalus cynoplossus)


Summer
Witch
Nfld.
P.E.I.
New Brunswick
-0-50 Fathoms
-51-100
-101-200
Nova Scotia
Weight / Tow (kg)
1 - 10
11 - 20
21 - 50
51 - 100
101 +
66°
64°
62°
60°
58°
48°
46°
44°

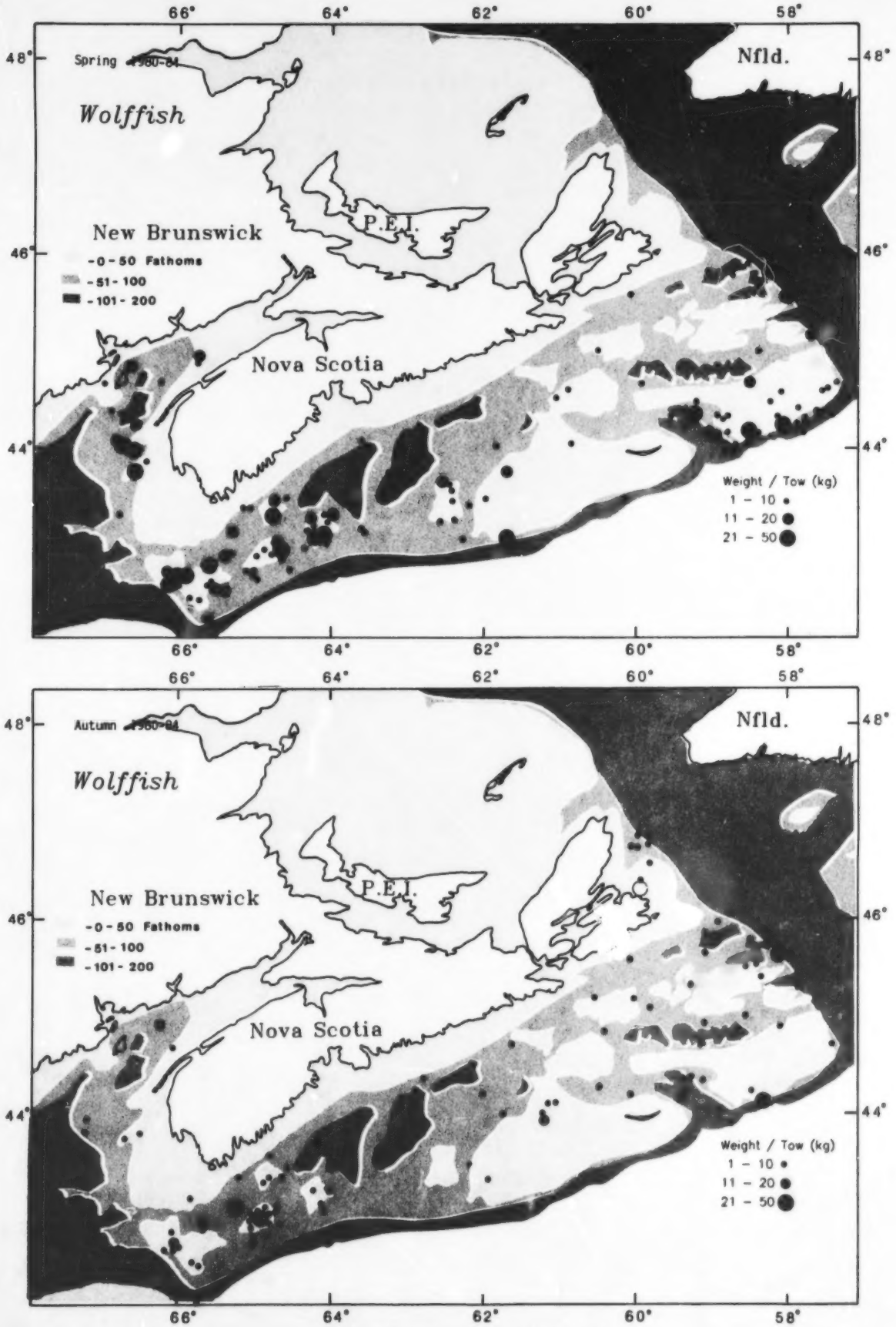
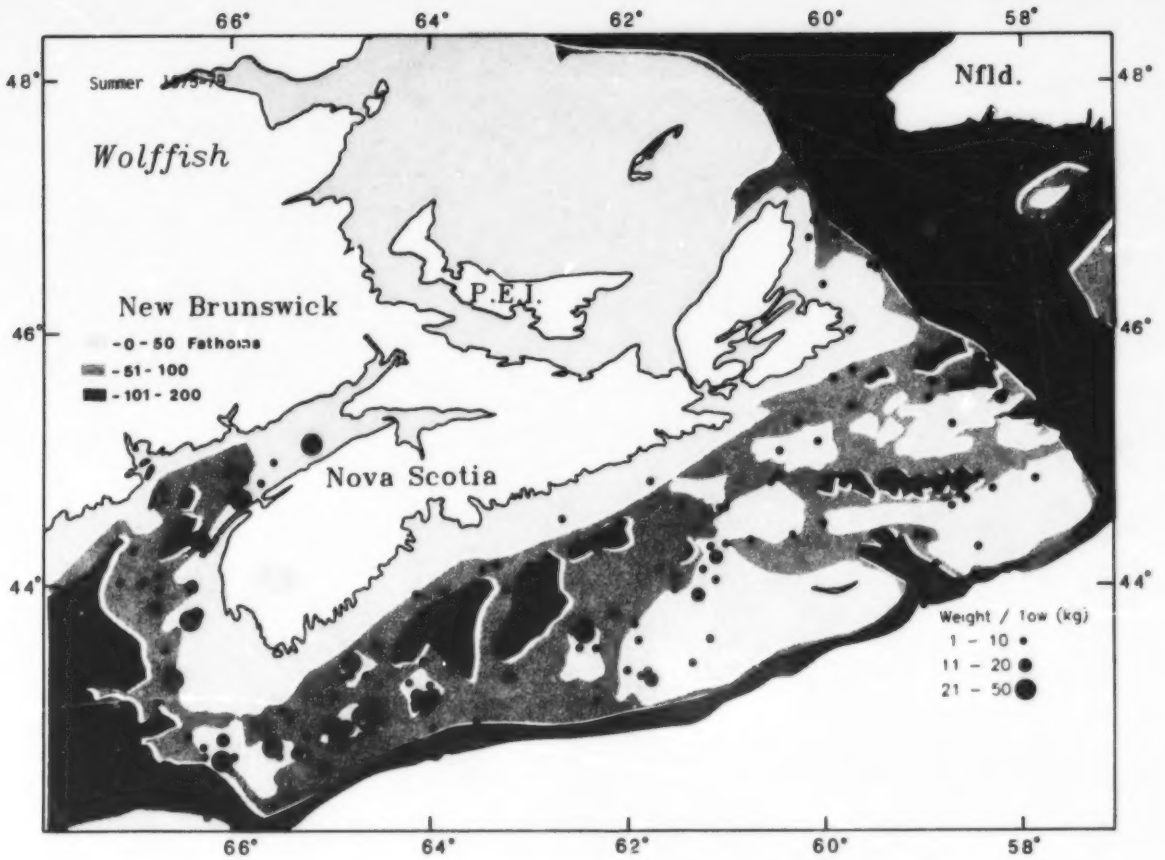
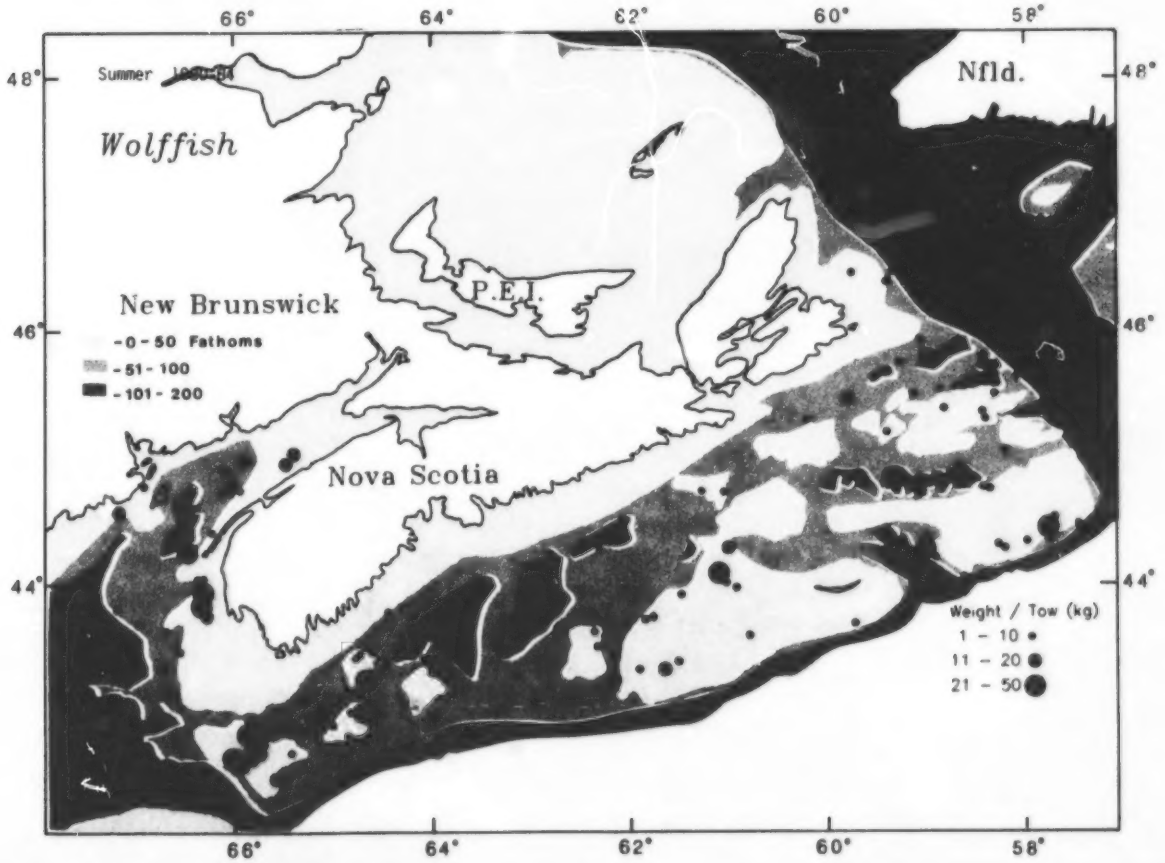


Fig. 32. Wolffish (Anarhichas lupus)


66°
64°
62°
60°
58°
48°
46°
44°
Summer
Wolffish
Nfld.
P.E.I.
New Brunswick
-0-50 Fathoms
-51-100
-101-200
Nova Scotia
Weight / Tow (kg)
1 - 10
11 - 20
21 - 50


66°
64°
62°
60°
58°
48°
46°
44°
Summer
Wolffish
Nfld.
P.E.I.
New Brunswick
-0-50 Fathoms
-51-100
-101-200
Nova Scotia
Weight / Tow (kg)
1 - 10
11 - 20
21 - 50

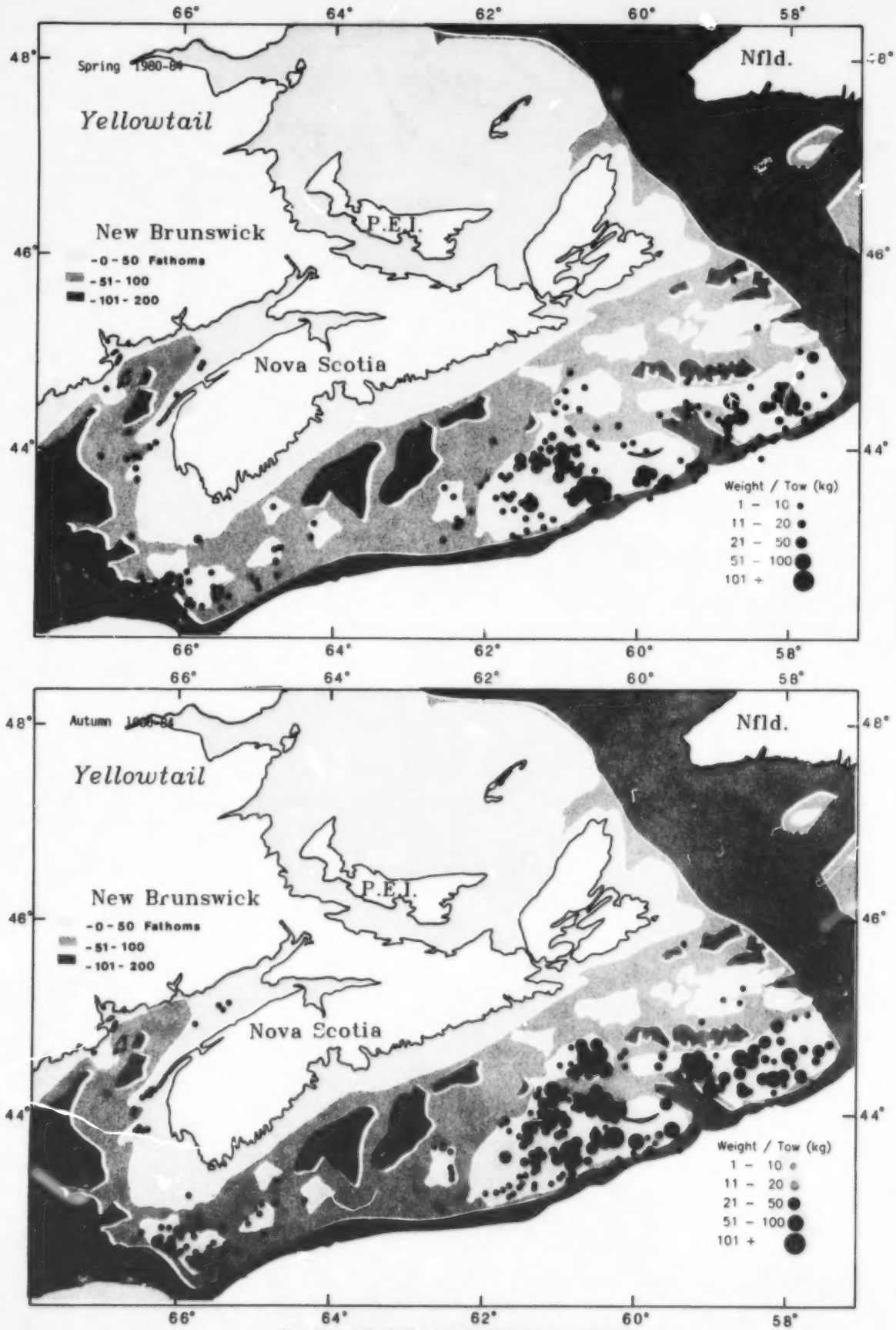
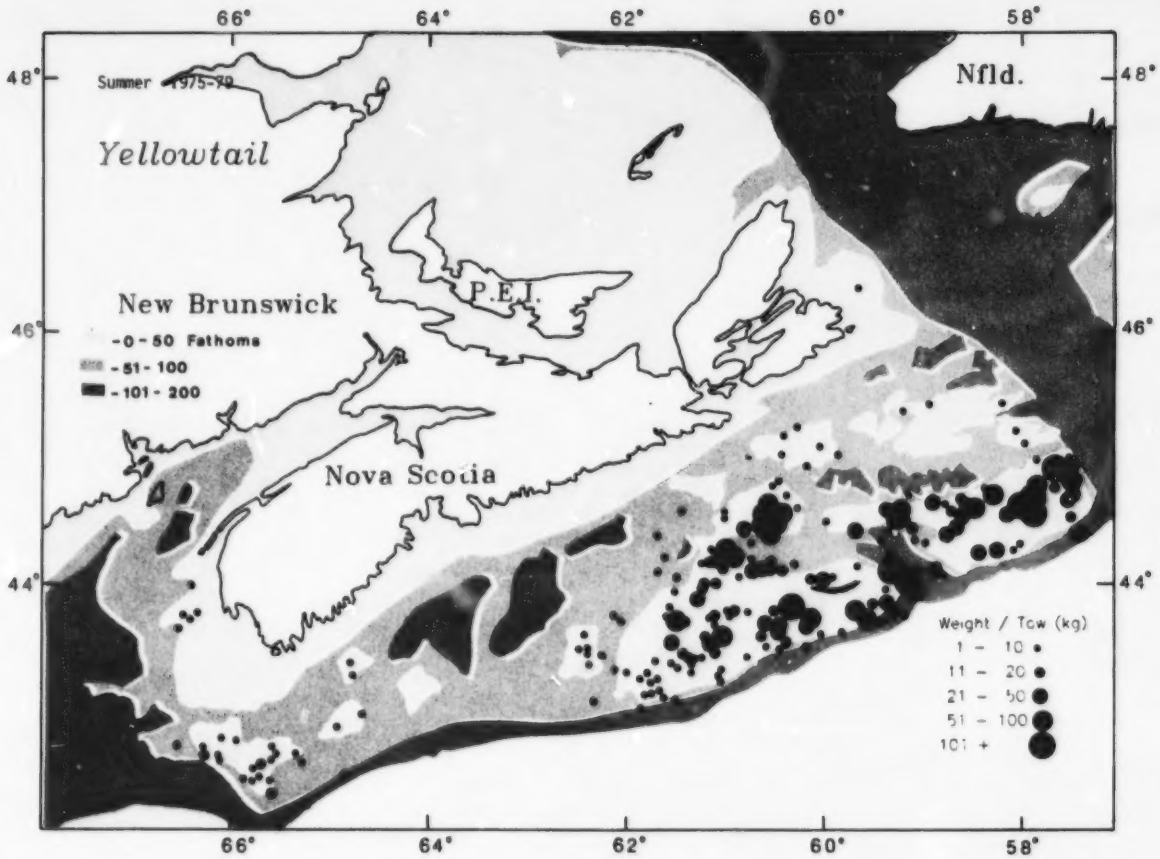
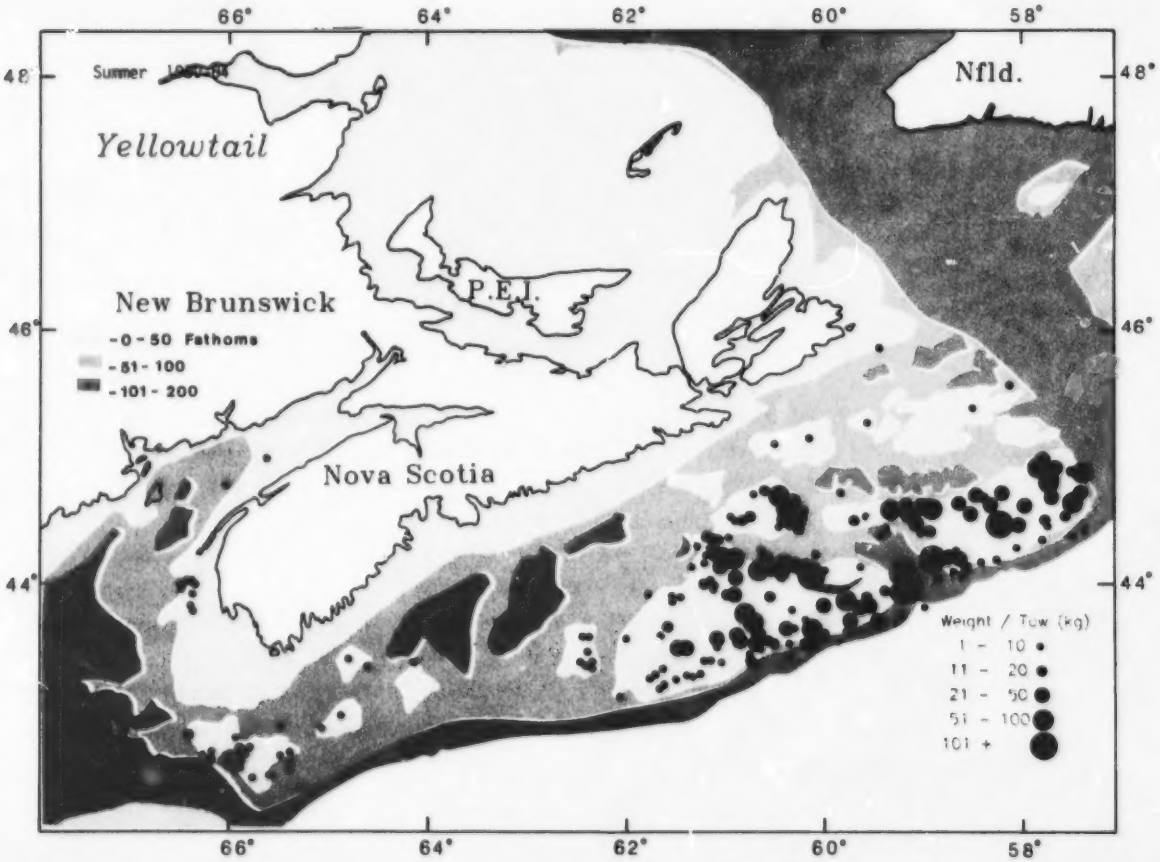


Fig. 33. Yellowtail flounder (Limanda ferruginea)


66°
64°
62°
60°
58°
48°
46°
44°
Summer 1975-79
Yellowtail
Nfld.
P.E.I.
New Brunswick
-0-50 Fathoms
-51-100
-101-200
Nova Scotia
Weight / Tow (kg)
1 - 10
11 - 20
21 - 50
51 - 100
101 +


66°
64°
62°
60°
58°
48°
46°
44°
Summer
Yellowtail
Nfld.
P.E.I.
New Brunswick
-0-50 Fathoms
-51-100
-101-200
Nova Scotia
Weight / Tow (kg)
1 - 10
11 - 20
21 - 50
51 - 100
101 +